Central Asian Gas in Eurasian Power Game

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Abstract

Following the dissolution of the Soviet Union, various gas pipeline projects have been proposed to diversify transit routes and export markets of the landlocked Central Asian states. To evaluate the pipeline project's impact on the players' bargaining power, I apply the cooperate game theory to a quantitative model of the Eurasian gas trade and quantify the bargaining power structure via the Shapley value. Due to ample production capacities in Central Asia, I observe little strategic interaction between the West and China. Thus, demand competition with China is not necessarily a disadvantage for the West, and the Turkmenistan-China pipeline does not affect the impact of the westbound projects aiming Europe and Turkey. For Turkmenistan, i.e., the main supplier in the region, a link via the Caspian Sea to Turkey is the most beneficial westbound option. Although the projects carrying gas from Azerbaijan and Turkmenistan to Europe enjoy the European Commission's political support, they yield marginal benefits to the European consumers. Thanks to its transit position, Turkey collects a large share of the benefits in the East-West gas trade.

Keywords: Bargaining Power, Network, Natural Gas, Central Asia, China
JEL class.: L5, L9, O22

1 Introduction

The dissolution of Soviet Union in 1991 bore three new sovereign states in Central Asia: Kazakhstan, Turkmenistan and Uzbekistan. Their proven conventional natural gas reserves amount to 27.8 tcm (trillion cubic metres), 13.3 % of the world's total. According to International Energy Agency (IEA), their total production will increase from 143 bcm (billion cubic metres) in 2009 to 265 bcm in 2035, and the region will become an important gas exporter (IEA, 2010a). Table 1 present the Central Asian states' proven reserves, production, consumption and net exports in detail.

The Central Asian states seek to derive maximum benefit from their rich natural gas reserves. Inheriting the Soviet pipeline network, they have relied on Russia for the bulk of their westbound gas exports (See Table 2 for Central Asian exports by destination.). The Russian dominance on gas transit and the poor access to alternative markets have set a low value on Central Asian gas. In order to increase revenues from their gas exports, the Central Asian states search for alternative pipeline projects which will diversify their transit routes as well as export markets. However, pipelines carrying Central Asian gas to distant markets have to pass through multiple countries which have their own strategic interests.

The Central Asian states' rich hydrocarbon reserves and unique geopolitical location have drawn attention of the global and regional powers for more than two centuries. Following the fall of the Soviet Union, the major powers have revived the contest for supremacy in Central Asia and thus, for control of the region's rich hydrocarbon reserves once again. Using pipelines as a strategic tool to realign Central Asian geopolitics, they seek to tap Central Asia's supplies as well as to block access of others to these. There are four major powers striving for potency in Central Asia: Europe and Turkey led by the USA in the West, ex-patron Russia in the North, rapidly growing China in the East and Iran seeking to become a regional power in the South. Energy hungry emerging countries in Asia such as India, Pakistan and South Korea may be added to the list as well.

In the second half of the nineties, the USA initiated *the pipeline game*[1] by propos-

[1] "The Great Game" denotes the struggle between Tsarist Russia and British Empire for hegemony in Central Asia in the 19th century. (Hopkirk, 1992). Referring to the Great Game, after the dissolution of the Soviet Union the competition between the major powers to build political clout in Eurasia and to gain access to Central Asia's rich hydrocarbon sources is called "the New Great Game" (Kleveman, 2004). In this paper, I limit the scope of the contest to the pipeline projects and name it as "the Pipeline Game".

Table 1: Natural Gas in Central Asia & Caspian Basin

Country[a]	Production [bcm]	Consumption [bcm]	Net Exports [bcm]	Proven reserves [tcm]	[%][b]
Azerbaijan	14.8	8.2	6.6	1.3	0.6
Kazakhstan	19.3	9.2	10.1	1.9	0.9
Turkmenistan	59.5	25.0	24.5	24.3	11.7
Uzbekistan	57.0	49.1	7.9	1.6	0.8
Total Central Asia[c]	135.8	83.3	42.5	27.8[d]	13.4

[a]Figures in bcm (billion cubic metres) and tcm (trillion cubic metres) for 2011, taken from BP(2012b). bcm: billion cubic meters, tcm: trillion cubic meters.

[b]Share of world total.

[c]Kazakhstan, Turkmenistan, Uzbekistan.

[d]In 2007, total proven gas reserves of the Central Asian states amounted to 6.2 tcm, which was only 3.5 % of the world's total proven gas reserves. Turkmenistan's proven reserves increased from 2.6 tcm in 2007 to 24.3 tcm in 2011 while Kazakhstan's and Uzbekistan's proven reserves remained unchanged (BP, 2012b). However, recognized sources disagree about development potential of Turkmenistan's fields, and their estimates of its proven reserves vary widely from 10 tcm to 24.3 tcm (Pirani, 2012).

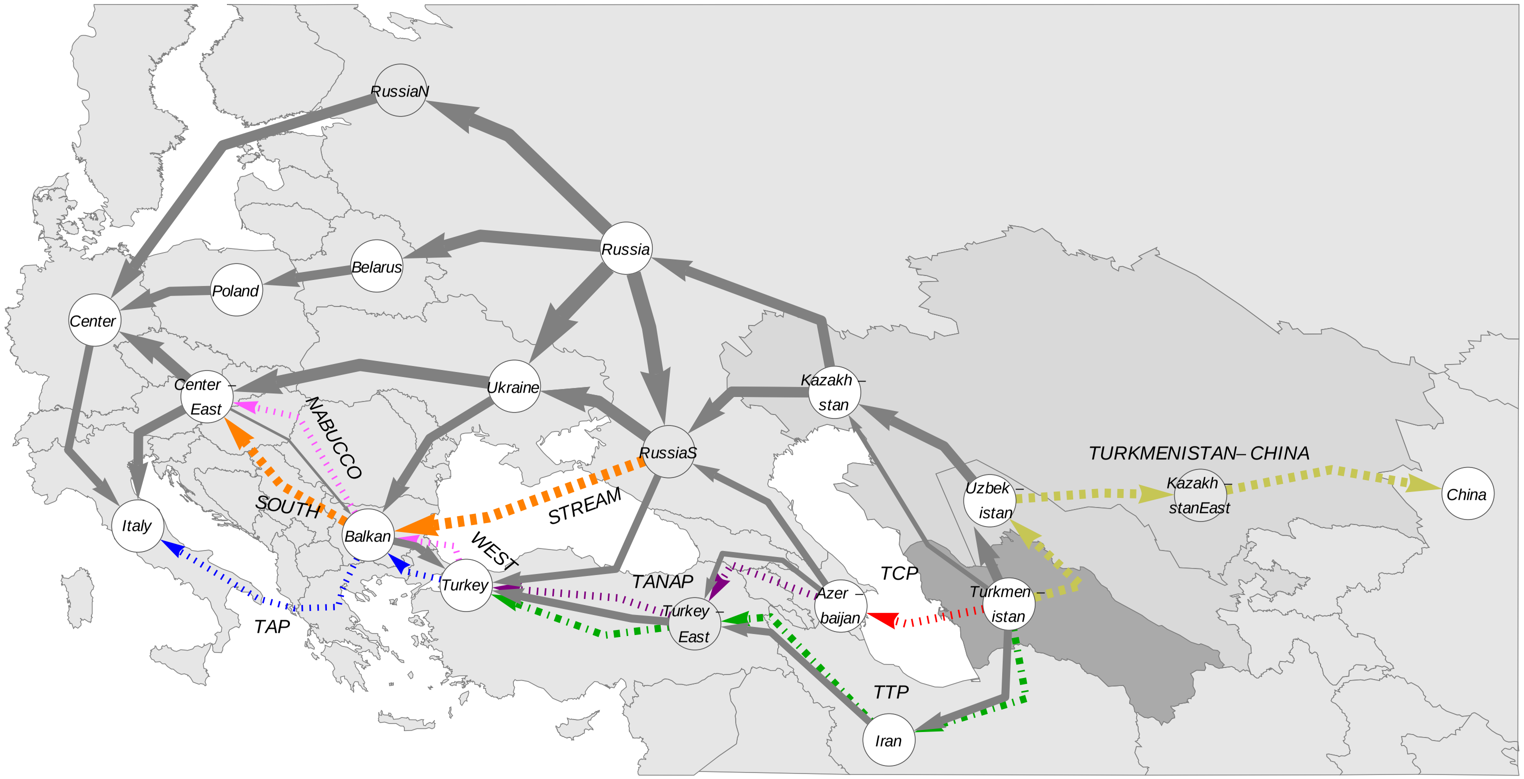
Table 2: Natural Gas Export from Central Asia & Caspian Basin

Exports to[a]	Azerbaijan	Kazakhstan	Turkmenistan	Uzbekistan
Russia	1.4	11.5	10.1	7.2
Iran	0.4	–	10.2	–
China	–	–	14.3	–
Turkey	3.8	–	–	–
Others	1.7	0.1	–	2.0

[a]Figures in bcm (billion cubic metres) for 2011, taken from BP(2012b). These countries are not necessarily the final market for Central Asian gas. They can transit it to third countries, e.g., Russia reexports Central Asian gas to Ukraine.

ing an offshore pipeline through the Caspian Sea. The project would mitigate the newly sovereign Central Asian states' dependence on Russia and would diversify imports of the USA's allies in the West. Following the American example, various westbound pipeline projects have been proposed: the Southern Corridor and the Trans Caspian pipeline (TCP) by Europe and Turkey, South Stream by Russia and the Turkmenistan Transcontinental pipeline (TTP) by Iran. Targeting European and Turkish markets, these projects will only diversify the transit routes for westbound Central Asian gas, but not introduce any new major markets. Instead of a westbound pipeline project, the Central Asian states chose to endorse the eastbound Turkmenistan-China pipeline. Completed in 2009, the project added the rapidly growing, energy hungry China as an alternative to the western markets and shifted the focus of the pipeline game eastwards (See the Figure 1.).

Figure 1: Pipeline Projects



Pipe2.pdf

The four pipeline options of the Central Asian countries are shown in dashed color: via China the Turkmenistan-China pipeline in Red; via Russia the South Stream pipeline in Orange, via Iran the Turkmenistan Transcontinental pipeline (TTP) in Green; via the Caspian Sea the Trans Caspian pipeline (TCP) in Blue, the Trans Anatolian pipeline (TANAP) in Dark Pink, the Nabucco-West pipeline in Magenta and the Trans Adriatic pipeline (TAP) in Light Blue. The international pipeline network as existing in 2012 is represented in gray solid lines. Western Europe, UK and Norway are considered in the analysis but left out in the picture. White circles stand for a transit node which is connected to production fields, consumer markets and LNG regasification plants if there are any. Gray circles are there only for transport purposes.

Recently, major developments have occurred in the westbound pipeline game. South Stream's construction was commenced by Russia and its partners. In the Southern Corridor the Trans Anatolian pipeline (TANAP) and the Trans Adriatic pipeline (TAP) were selected, leading to the cancellation of Nabucco (-West). The projects' constructions are expected to start in 2014 and 2015, respectively. TCP through the Caspian Sea and TTP through Iran may connect the Central Asian states to the Southern Corridor. However, both options encounter political problems, hindering their realization any time soon (see section 2 for a detailed presentation of the pipelines.).

In this study, I analyze the selected pipeline projects' impact on the bargaining power structure in the Eurasian gas trade. Firstly, I consider the situation before the inauguration of the Turkmenistan-China pipeline and investigate the Central Asian countries' choice of heading eastwards to China instead of westwards to Europe. Then, I return to the current state of the Eurasian pipeline game to study the demand competition for Central Asian gas between the West and China. I examine how the Turkmenistan-China pipeline alters the westbound pipeline projects' impact on the bargaining power structure. Finally, in the presence of the Turkmenistan-China pipeline, I check the most beneficial westbound pipeline project for the Central Asian countries. In the Southern Corridor, I investigate the recently finalized contest between TAP and Nabucco-West.

The study uses the disaggregated quantitative model of the Eurasian gas trade and the cooperative approach presented in Hubert & Cobanli (2012) and Hubert & Orlova (2012). To investigate the role of Central Asian gas and China, I adapt the model's geographical frame by leaving out some players in the West and adding the players as well as the pipeline network in the East. The cooperative approach represents the interdependence among the players in value function form, which captures essential economic features of the Eurasian gas trade, especially the architecture of the pipeline network. The game is solved with the Shapley value, which is interpreted as the bargaining power in the paper. It allocates the surplus from the cooperation among the players by taking their interdependencies into account. Since the introduction of a new pipeline alters the pipeline network, the interaction among the players and thus, their Shapley values change consequently. I compare a player's Shapley values before and after the introduction of a pipeline project to derive its strategic impact on the player's bargaining power. Later, the pipeline's impact on different stakeholders is compared with its cost to analyze its viability.

The Central Asian states' rich energy sources and the pipeline contest among the major players for hegemony in the region have been addressed by several studies, e.g., Downs (2004), Kleveman (2004), Dorian (2006), Olcott (2006), and Chow & Hendrix (2010). However, this line of the literature has made no attempt to quantify the impact of the Central Asian states' pipeline options on the bargaining power structure in Eurasia. Grais & Zheng (1996), Boots et al. (2004), von Hirschhausen et al. (2005), Egging & Gabriel (2006), and Holz et al. (2008) apply the non-cooperative game theory on different quantitative models of the Eurasian gas trade. While these studies examine the European gas market and its relation with Russia in detail, the Central Asian states and China have received little attention. This study distinguishes itself from the mentioned applied studies with its objective and modeling approach. Considering the Central Asian states' outside option, China, it investigates their motives in the Eurasian gas trade and examines the interaction between the West and China. The analysis of the Southern Corridor clarifies the players' motives to endorse different pipeline projects and provides insight for the future projects carrying Central Asian and/or Middle Eastern gas to the European and Turkish markets. In contrast to the widely applied non-cooperative approach, the study models the interdependence among the players via the cooperative game theory. From the modeling perspective, Hubert & Cobanli (2012) and Hubert & Orlova (2012) are closest to this study. However, their focus is again on the European market.

My four most important findings are as follows: (i) Due to ample production capacities in Central Asia, there is no strategic interaction between the West and China and thus, little demand competition for Central Asian gas. (ii) As a result, the Turkmenistan-China pipeline does not affect the strategic impact of the westbound pipeline options on the bargaining power structure. (iii) For Turkmenistan a link via the Caspian Sea to Turkey is the most beneficial westbound option. (iv) Although the European Commission (EC) endorses the projects linking the Caspian Region and Central Asia to the European markets, Azerbaijani and Turkmen supplies bring marginal gains to the European consumers.

The next section presents the background and the selected pipeline projects in their political and historical context. Section 3 discusses strengths of the cooperative game theory over its more widely used non-cooperative counterpart to analyze the bargaining power structure in the Eurasian gas trade. It explains how a pipeline project may alter the strategic interaction among the players and portrays the model in detail. Section 4 evaluates the selected pipeline projects and presents the results.

Section 5 checks the robustness of the results according to investment options and demand. Section 6 summarizes main findings and concludes.

2 Background & Pipelines

The Central Asian countries have a number of options to diversify their transport routes as well as export markets. While there is only the Turkmenistan-China pipeline to reach eastwards, three routes extend from Central Asia to the West: via the Caspian Sea, via Iran, and via Russia (see the Figure 1). In this section, I present the background and the selected pipeline projects on the routes in detail. I discuss strategic motivations of stakeholders and obstacles to undertake these projects.

2.1 Dependence on Russia

Constructed in Soviet times, the Central Asia-Center (CAC) gas pipeline system transits the bulk of Central Asian gas to the Russian mainland in Europe and from there westwards to European and Ukrainian markets. Before the commissioning of the Iranian link in 1997, it was the only pipeline connecting the Central Asian suppliers to consumer markets. The CAC gas pipeline system consists of two branches. The main eastern branch links gas fields in southeastern Turkmenistan through Uzbekistan to Kazakhstan, while the relatively small western branch carries gas from small fields scattered in western Turkmenistan directly to Kazakhstan. Then, the two branches join in the West of Kazakhstan and join to the Russian pipeline system in the North. Since the last branch's completion in 1985, the pipeline system's initial capacity of 80 bcm/a (billion cubic metres per annum) has decreased significantly due to lack of maintenance and repair. In May 2007, Russia and the Central Asian states signed an intergovernmental agreement to renovate the current CAC pipeline system and declared their interest in building the Pre-Caspian gas pipeline. The 1700 km long pipeline will follow the same route as the western branch of the CAC system and will connect Turkmenistan via Kazakhstan to the Russian pipeline system (Gazprom, 2013). Russia controls transmission through the CAC pipeline system. The mid-term contracts signed between Russia's Gazprom and Kazakhstan's Intergas Central Asia in November 2005 allow Gazprom to transit Russian and Central Asian gas through Kazakhstan. A similar mid-term agreement with Uzbekistan's Uztransgaz in September 2005 gives Russia transit rights through Uzbekistan (Gazprom, 2011).

Central Asian gas plays an important role in Russian gas balance. Russia's giant fields in western Siberia, i.e. Yamburg, Urengoy and Medvezhye are mature, and production in these fields is in long-term decline. Russia has to develop new fields in Yamal peninsula, East Siberia and Far East to satisfy its growing domestic demand and to fulfill its supply commitments to European markets (IEA, 2009). Development of new fields in Yamal peninsula is technologically demanding and capital intensive due to extreme environmental conditions,and fields in East Siberia and Far East are far away from European markets and are earmarked rather for exports to Asia-Pacific markets. Since the Central Asian fields have lower well-head production cost and are closer to the western markets than the Russian alternatives, Russia signed several gas purchase and upstream investment agreements with the Central Asian states to serve its supply commitments in the short run and strengthened its grip in the Central Asian states. Kazakhstan is Russia's closest partner in the region. KazRosGaz, a Russian-Kazakh joint venture, conducts processing of Kazakh gas in Russian plants and marketing of it in Russia and other export markets. While in 2003 Turkmenistan agreed to deliver 2 tcm over 25 years to Russia (Olcott, 2006), the long-term purchase agreement with Uzbekistan expired in 2012. Russia collaborates with Kazakhstan in the Tsentralnaya and Karachaganak fields and with Uzbekistan in the Shakhpakhty and Dzhel fields (Gazprom, 2011).

The Russia-Ukraine gas disputes raised concerns about that Russia may use its dominance on gas transit to exert political as well as economic pressure on the Central Asian countries. In 2006 and 2009, the disputes between Russia and Ukraine over gas prices, transit volumes and accumulated Ukrainian debt led to disruptions of westbound Russian supplies transited through Ukraine.[2] Disruption of Russian supplies caused severe gas shortages in Europe, especially in the Balkans with dire consequences for power supply and heating in the high winter. With gas disruptions Russia aimed to increase Ukrainian import price close to the European netback price and to get concessions about gas import tariffs through Ukraine.[3] Russia compelled Ukraine to sell equity shares in the Ukrainian transit and storage systems in exchange of low gas prices and accumulated Ukrainian debt from gas

[2]Russian gas accounts for a quarter of European consumption and 40% of its imports. Before the completion of Nord Stream in 2011, around 80% of Russian supplies were carried through Ukraine to the European markets.

[3]Netback price at a location is calculated by gas price in a target market less costs associated with transporting gas from the location to the target market such as tariffs, operation & management cost of pipelines, etc. In this case, European netback price at the eastern Ukrainian border is gas price at the eastern German border less the transportation and transit costs to carry gas from the eastern Ukrainian border to the eastern German border.

trade (Pirani et al, 2009). The Central Asian states aim to add alternative transit routes (i.e., an outside option) to the CAC pipeline system and thus, to strengthen their bargaining power vis-a-vis Russia.

While Russia reexports Central Asian gas to the low paying Commonwealth of Independent States (CIS) such as Ukraine, it keeps the more profitable European markets for itself and avoids supply competition with the Central Asian states in these markets (Olcott, 2006). The Central Asian states' dependence on Russia and the lack of alternative transit routes had set low value on Central Asian gas. Before 2004, Turkmenistan was receiving 36 $/mcm from Russia, while the average European gas price was 136 $/mcm (Bilgin, 2009). For the period from 2004 to 2009 the IEA calculated the European netback price at the Turkmenistan-Uzbekistan border and compared it with Turkmenistan's export price. In this five years period, Turkmenistan could benefit $25.9 billion more from international gas trade. Most of the rent from gas trade accrued to Turkmenistan's primary export market, Ukraine and the transit country, Russia (IEA, 2009). Observing the disparity in gas prices, the Central Asian countries seek to increase demand as well as transit competition for their gas, and thus, the gas price.

2.2 To the West

2.2.1 Via the Caspian Sea and the Southern Corridor

The Russia-Ukraine gas disputes in the last decade and consequential disruptions of Russian deliveries tainted Russia's reliability as the dominant supplier to the European markets and raised concerns about the European Union's (EU) supply security. In order to diversify the EU's imports and thus, to increase its supply security, the EC initiated the Southern Corridor and listed the Nabucco pipeline in its Trans-European Energy Networks (TEN-E) (EC, 2006). The EC gave its full support to Nabucco at Budapest Summit organized right after the Russia-Ukraine gas crisis in 2009 (Nabucco, 2013).Nabucco would carry Central Asian as well as Middle Eastern gas from the eastern and southern borders of Turkey through Bulgaria, Romania and Hungary to Austria. Its consortium was composed by only consumers and transit countries, i.e. Germany's RWE, Austria's OMV, Hungary's FGSZ, Romania's Transgaz, Bulgaria's Bulgargaz EAD, and Turkey's BOTAS, but no suppliers.[4] The project's long range and large capacity of 31 bcm/a raised its

[4] FGSZ is 100% subsidiary of MOL, Hungary's national champion in natural gas. In April 2013, Germany's RWE dropped out of Nabucco's consortium and sold its 16.7% stake to Austria's OMV

cost to 17.6 billion €.

Nabucco's consortium experienced difficulties to fill the project's large capacity of 31 bcm/a. In order to link the Central Asian suppliers to Nabucco, the EC revived TCP. The project was initiated by the USA in the second half of the 1990s to mitigate the Central Asian states' dependence on Russia, but it had to be shelved due to low European demand prospects as well as disagreement over the Caspian Sea's status. TCP would connect Turkmenistan via an offshore pipeline under the Caspian Sea to Azerbaijan. With a capacity of 20 bcm/a, the project's cost is estimated at 3.5 billion €. Since 2009, the EU considers the concept of Caspian Development Corporation to promote European investment in the project (IHS CERA, 2010). The current transit countries for Central Asian gas, Russia and Iran strongly object TCP since the project will open a new third transit route for westbound Central Asian gas exports and will bypass them.

The Caspian Sea's status is the major obstacle to the construction of TCP. Following the dissolution of the Soviet Union, its unique geography and rich hydrocarbon resources have caused disagreements between the five littoral states, i.e., Russia, Iran, Azerbaijan, Kazakhstan and Turkmenistan about demarcation and exploitation of these resources. In the 1990s, Russia and Iran stood for condominium and consensus principles to hinder any participation of the Western powers in Caspian energy projects. According to these principles, all littoral states should agree on any project regarding Caspian resources which will be exploited on a shared basis. On the other hand, the newly sovereign states and the Western powers supported the application of the international law of sea and division of the seabed on an equidistant basis. At the end of the 1990s, pressure of Russian oil companies shifted the Russian stand from condominium to division of the seabed and left Iran isolated. The northern littoral states settled the demarcation of the the Caspian Sea through several bilateral agreements, while the status of the Southern Caspian Sea is still unclear. Azerbaijan and Turkmenistan came to term according to an equidistant division of the seabed, but they still dispute over exploitation of the Kyapaz and Chirag oil fields (Mehdiyoun, 2000). Technical difficulties regarding the construction of the pipeline are other obstacles to overcome.

Currently, political conflicts in Middle East and Caspian Region have left Azerbaijan's Shah Deniz field as the only supplier of the Southern Corridor. With its proven reserves of 1 tcm, the Shah Deniz field is one of the largest fields in the world. UK's

(Reuters, 2013b). In May 2013, France's GDF Suez bought 9% stake from OMV and joined in the project's consortium (OGJ, 2013).

BP and Norway's StatOil are the major shareholders in the Shah Deniz field's consortium while Azerbaijan's SOCAR, France's Total, Russia's and Italy's LukAgip, Iran's NIOC and Turkey's TPAO hold smaller shares. The first stage of the field, Shah Deniz I, has been in operation since 2006 and can serve up to 9 bcm/a. Azerbaijani supplies are carried via the South Caucasus pipeline (SCP), which has a capacity of 7 bcm/a, through Georgia to Eastern Turkey. The second stage of the field, Shah Deniz II field, is currently under development and will increase the supply capacity by 16 bcm/a. While 6 bcm/a of these additional supplies will be delivered to Turkey, 10 bcm/a will be carried further to European markets. In order to ship its supplies to the Southern Corridor, the Shah Deniz field's consortium seeks to increase the SCP's capacity by 16 bcm/a. It plans the first shipment to Turkey in 2018 and to Europe in 2019 (BP, 2012a). If TCP is realized, the SCP's capacity will be increased further to carry Central Asian gas from the West Caspian coast to the Southern Corridor.

Following the failure of Nabucco's consortium to realize the project, Turkey and Azerbaijan initiated the Trans Anatolia pipeline (TANAP) in December 2011. Covering Nabucco's eastern section in Turkey, the project intends to carry Azerbaijani as well as Central Asian gas from the Georgia-Turkey border to the Turkey-EU border. The project's consortium is led by Azerbaijan's SOCAR and includes Turkey's BOTAS and TPAO as small partners. The Shah Deniz field's consortium agreed to take over shares in TANAP's consortium in the near future (Trend, 2013). The major stakeholders in the Shah Deniz field's consortium, i.e., UK's BP and Norway's Statoil will receive 12% each, while France's Total will get 5%. The pipeline is designed to have an initial capacity of 16 bcm/a, but it can be expanded to deliver additional Central Asian gas (TANAP, 2013). The project's cost is estimated at 4.8 billion €.

The lack of supply commitments and the high project cost compelled Nabucco's consortium to downsize the project's range and capacity. In May 2012, the consortium proposed the Nabucco-West pipeline and left Nabucco's eastern section in Turkey to TANAP. Nabucco-West focused only on the section in the EU's territory and would follow the same route as Nabucco from Turkey's western border to Austria. The initial capacity of the pipeline was cut substantially to 10 bcm/a, but it could be increased up to 23 bcm/a (Nabucco, 2013). Decreases in the project's range and capacity were passed through to its cost, which was estimated at 5 billion €. However, problems of Nabucco-West were not limited to the lack of supply commitments and high cost. It also faced competition from TAP for transit of Azerbaijani gas from the Turkey-EU border to Central and Western European markets.

TAP will start on the Turkey-Greece border and after crossing Greece and Albania it will reach via an offshore pipeline under the Adriatic Sea to Italy. It has the same capacity (10 bcm/a) as Nabucco-West, but costing 3.3 billion €, it is cheaper than its rival. The initial capacity of the pipeline can be increased to 20 bcm/a depending on supply and demand. In 2007, Switzerland's EGL, Norway's Statoil and Germany's E.ON initiated the project. In July 2013, the incorporation of the Shah Deniz consortium's major members and Belgium's Fluxys gave TAP's consortium its final structure: BP (20 %), SOCAR (20 %), Statoil (20 %), Fluxys (16 %), Total (10 %), E.ON (9 %) and Axpo (5 %) (TAP, 2013). Being a major gas infrastructure group, Fluxys operates and owns various cross-border pipelines in Europe which have a key role in North-South gas transit. Fluxys' participation in the project indicates that Italy will not be the final destination for Azerbaijani gas, and it will be transited further to Central and Northern European markets.

The Balkans are isolated from the rest of the European markets since there is little transit capacity linking the Balkans to Central Europe (1.7 bcm/a). Connecting the Balkans to Central Europe with a capacity of 10 bcm/a, TAP and Nabucco-West both have potential to change this, but they differ in their third party access regimes, i.e., who can ship gas through the pipelines. The EU's internal market regulation for gas obliges a pipeline operator to grant third parties nondiscriminatory access to its network (EC, 2003, 2005, 2009). Thus, a player cannot gain bargaining power by blocking access of other players to its network. However, under strict control of the EC, national regulators can grant exemption from the EU's third party access regulation for a limited time in order to facilitate investment.[5] While in 2008 the EC exempted half of Nabucco-West's capacity (5 bcm/a) from the EU's third party access regulation (EC, 2013), TAP's consortium secured exemption for its full capacity (10 bcm/a) in May 2013 (TAP, 2013).

In June 2013, the Shah Deniz consortium entitled TAP to carry Azerbaijani gas in the European territory and brought the four years long competition between TAP and Nabucco-West to an end (BP, 2013). As the final route, TANAP and TAP will carry Azerbaijani gas to European markets. The participation of the Shah Deniz field's shareholders in the projects' consortia indicates a commitment on part of the supplier to deliver gas to European markets. Thus, the supplier will bear part of the infrastructure cost to ship gas westwards.

[5]See Article 36 Directive 2009/73/EC for criteria which have to be met for exemption from the EU's third party access regulation (EC, 2009).

2.2.2 Via Iran and the Southern Corridor

Iran, too, seeks to become a transit country for westbound Central Asian gas exports.[6] Being the second largest in the world, Iran's gas reserves amount to 33 tcm, 15.9% of the world total (BP, 2012b). However, its indigenous production is barely enough to cover its domestic demand due to high subsidies on consumption and western sanctions on investments in Iran. With international pipeline projects, Iran aims to court investment and expertise for its underdeveloped pipeline infrastructure and gas fields. Thus, Iran wants to pave its way to become a global gas supplier and to control flow of competing Central Asian gas to major markets.

Although Iran and Turkey have diverging geopolitical interests in Central Asia, they accord in transit of Central Asian gas. In the 1990s, Turkey was interested in Turkmen gas to satisfy its rapidly growing consumption and sought to become a transit country on the route to European markets. In 1995, Iran, Turkey and Turkmenistan initiated TTP. The 1400 km long pipeline would carry 15-25 bcm/a of Turkmen gas through Iran to Turkey, and 10 bcm/a of shipments would be shipped further to European markets. However, opposing Iran's involvement in Eurasian gas trade, the US blocked international financing for the project, and Iran had to content itself with the modest Korpeje-Kordkuy pipeline, which connects the relatively small fields in Western Turkmenistan to remote Northern Iran with a capacity of 8 bcm/a (Olcott, 2006).

In 1997, Iran, Turkey and Turkmenistan revived TTP and signed a memorandum of understanding for delivery of 30 bcm/a of Turkmen gas to Turkish market. Following the softening in the US' position, the Tabriz-Ankara pipeline was inaugurated in 2001. The 2500 km long pipeline can carry up to 14 bcm/a of Iranian gas freed by Turkmen deliveries to Eastern Turkey. However, the financial crisis in 2001 caused a sharp cut in Turkey's gas demand forecast, and Turkey lost its interest in Turkmen gas considering the newly proposed offshore Blue Stream pipeline and SCP, which carry Russian and Azerbaijani supplies, respectively to the Turkish market (Olcott, 2006).

Although Iran's nuclear program toughened the West's opposition to Iran's role in transit of Turkmen gas and international sanctions make any capital intensive investment in Iran's gas infrastructure unlikely, Iran is still able to build short range

[6]The other option is to supply the gas southwards to emerging economies, i.e. India and Pakistan. Since early 1990s the Iran-Pakistan pipeline is under discussion. It may be extended further to India and China. Central Asian gas may also be carried to the Iranian coast on Persian Gulf and from there via liquefied natural gas (LNG) vessels to world markets.

pipelines to tap Turkmenistan's gas fields. In 2010, the opening of the 180 km long Dauletabad-Sarakhs-Khangiran pipeline increased Turkmenistan's export capacity to Iran from 8 bcm/a to 20 bcm/a (BBC, 2010). In this study, I analyze TTP. The project will extend the existing capacities by 15 bcm/a and will carry Turkmen supplies from the Dauletabad field through Northern Iran to Eastern Turkey. From there the Southern Corridor (i.e., TANAP and TAP) will transit Turkmen gas further to the Balkans and European markets. I estimate the cost of the project at 9.8 billion € and assume that the Turkish and Iranian companies will build the project jointly without any participation of western companies.

2.2.3 Via Russia

South Stream proposed by Russia is often viewed as an attempt to counter threats from the alternative pipeline projects, especially from the Southern Corridor. The project will link Russia to Bulgaria via an offshore pipeline under Black Sea and will reach Austria as well as Northern Italy after crossing Serbia and Hungary. On the one hand, bypassing Ukraine, South Stream will enhance the EU's supply security. On the other hand, the project will not introduce any new suppliers to European markets. It will divert Europe-bound gas from existing sources, i.e., the Russian fields and the Central Asian suppliers, from the route via Ukraine to the offshore pipeline. Europe is concerned that South Stream will lock up Central Asian supplies necessary to fill the Southern Corridor's pipeline capacities and thus, may preempt investment in the project.

Locking up supplies from the Central Asian countries, Russia aims to forestall investment in the Southern Corridor, which needs supply commitments to fill its pipeline capacities. Thus, Russia tries to maintain its dominance on the transit of Central Asian supplies to western markets and to avoid supply competition with Central Asian gas in its major export markets.

Being the leading investor in South Stream, Russia's Gazprom has spent considerable resources to push the project. The project's onshore and offshore sections have different partnership structures. In 2007, Russia's Gazprom and Italy's Eni initiated South Stream. In 2010, France's EDF and in 2011, Germany's Wintershall bought part of Eni's shares and joined the project's offshore section. While with 50% Gazprom is the largest shareholder in South Stream's offshore section, Eni, EDF and Wintershall controls 20%, 15% and 15% of shares, respectively. Gazprom incorporated several joint companies with the national champions of the countries on the onshore route. The offshore section's capacity of 63 bcm/a will decrease to 30 bcm/a ashore. The lengthy offshore section boosts the project's cost to 15.5 billion €, which is far higher than the cost of other projects competing for transit of westbound Central Asian gas. The Russian domestic pipeline system has to be upgraded to serve the offshore section of South Stream. The domestic upgrade costs an additional 12.5 billion €, and the total cost of South Stream increases to 28 billion € (Reuters, 2013a).

In 2011, South Stream overcame a major obstacle by receiving permission to build in the territorial waters of Turkey, which has large interests in the Southern Corridor (South Stream, 2013). Although questions about regulation and construction permits in the EU's territory as well as financing of the whole project are still open, Gazprom and its partners started the construction of the offshore section in December 2012 (FT, 2012). The project's consortium expects that first gas through the pipeline will be commissioned in 2015 (South Stream, 2013).

South Stream's consortium seeks exemption from the EU's third party access regulation and desires to be listed as a project of European interest in the TEN-E (EurActiv, 2012). I assume that South Stream's onshore section in the EU's territory will be granted exemption from the EU's third party access regulation although the EC has denied any motion to this direction so far. As shown in Hubert & Cobanli (2012), the onshore section's subjection to the EU's third party access regulation would introduce alternative suppliers to Russia's export markets. While Norway and Netherlands would ship gas eastwards to the Balkans and Turkey, the Eastern suppliers would enter the Central and Western European markets. Thus, intensified supply competition would threaten the Russian dominance in its export markets.

2.3 To the East

China seeks to increase the share of gas in its energy consumption to 10% by 2020 to diversify its fuel mix as well as to mitigate high pollution from its coal based energy production. In 2007, for the first time China's gas consumption surpassed its indigenous production, and the gap between consumption and indigenous production has been widening with an increasing pace (EIA, 2013). The IEA projects that in 2015, China's consumption will hit 197 bcm, and it will import 62 bcm via pipelines and LNG regasification plants to meet its demand (IEA , 2011b).

In order to serve its rapidly increasing domestic demand, China looks at gas rich Central Asia. In 2003, China and Kazakhstan announced their preliminary plan for a Central Asian gas pipeline. In 2007, Turkmenistan and Uzbekistan joined the project and established the Turkmenistan-China pipeline, which introduced an outside option, i.e., China as an alternative major market to the westbound Eurasian pipeline game. Inaugurated in December 2009, the Turkmenistan-China pipeline starts from the Bagtyyarlyk field in East Turkmenistan. After crossing Uzbekistan and southern Kazakhstan the pipeline meets the second West-East pipeline in Northwest China. The 1833 km long pipeline has a capacity of 30 bcm/a (CNPC, 2013), and its cost is estimated at 9 billion €. The project was initiated by China's CNPC and undertaken together with local companies, i.e., Kazakhtan's KazMunayGas, Turkmenistan's Turkmengas and Uzbekistan's Uzbekneftegas. From Northwest China Central Asian gas is carried via the 4850 km long second West-East pipeline to demand centers in East China. Together with eight sub-lines the total length of the project sums up to 8650 km. the The pipeline has a capacity of 30 bcm/a and costs 7 billion €.

Turkmenistan is the main supplier of the pipeline, but in the near future the transit countries, Uzbekistan and Kazakhstan, will supply relatively small volumes as well. In 2007, Turkmenistan agreed to deliver 30 bcm/a through the Turkmenistan-China pipeline to China for 30 years (CNPC, 2013) and increased its supply commitment to 50 bcm/a in 2012. Kazakhstan's major production fields in the West and North-West are disconnected from the Turkmenistan-China pipeline lying in the South of the country. In 2010, Kazakhstan and China agreed to build a 1400 km long pipeline to link Kazakhstan's major production fields to the Turkmenistan-China pipeline. According to the agreement, Kazakhstan will supply 10 bcm/a to China. In 2011, China signed a similar agreement with Uzbekistan to import 10 bcm/a (EIA, 2013). The third leg of the Turkmenistan-China pipeline is under consideration to carry these additional supplies to the Chinese market. China signed several upstream investment agreements with the Central Asian countries. Currently, China's NOC operates the Bagtyyarlyk field in Turkmenistan, which supplies the Turkmenistan-China pipeline. In December 2009, China secured a production sharing agreement to develop the rich South Yolotan field in Turkmenistan. The first delivery from the South Yolotan field is expected by 2013.

For Russia, the Turkmenistan-China pipeline cuts two ways. On the one hand, linking China to Central Asia, the pipeline increases demand competition for Central Asian gas and challenges Russia's position as the dominant importer. Moreover, the pipeline strengthens supply competition in the Chinese market, which Russia considers as a potential export market in the near future. On the other hand, the pipeline interlocks Central Asian supplies necessary for the realization of the Southern Corridor and safeguards Russia's transit dominance on the westbound Central Asian gas as well as its market share in western markets. These may explain why Russia did not oppose the Turkmenistan-China pipeline introducing China to its area of influence.

3 The Model

With its distinct stages of production, transit and distribution the Eurasian gas trade exhibits a vertical structure. Players at different stages have their respective market power; e.g., Russia in production and Ukraine in transit. A player with market power sets a mark-up on marginal cost, which yields a deadweight loss and, thus an inefficiency in the market. Since deadweight losses occurs at every stage with market power, the total surplus suffers due to the double marginalization. To address this issue, long term contracts are widely used in international gas trade. They specify the price as well as the quantity of gas, and their take-or-pay clauses secure a steady and foreseeable income to suppliers. Thus, they ensure efficient exploitation of the pipeline network and avoid double marginalization in the vertical structure.

As discussed in Hubert & Ikonnikova (2011), the cooperative approach has two major advantages over the non-cooperative approach in the analysis of a vertical structure such as the Eurasian gas trade. Firstly, in accordance with the long term contracts, the cooperative approach assumes that the players negotiate efficiently and avoids any restrictive assumptions about the players' action space. On the contrary, the non-cooperative approach restricts the action space of the players to prices or quantities. Combined with market power in the Eurasian gas trade, counterfactual restrictions on the long term contracts cause inefficiencies in the model. Second, the cooperative approach relies on the outcomes of the coalitions formed by different combinations of the players, and the players' roles in the gas supply chain reveal their power endogenously. In contrast, the non-cooperative approach defines the sequence of actions precisely. The outcome of the game depends on who moves first, e.g. the suppliers set the price or the consumers decide their demand. Since the first mover has the ability to commit, distribution of surplus is distorted in its favor. A change in the sequence of actions alters the outcome of the game considerably. Therefore, the paper uses the cooperative approach to derive the power structure in the Eurasian gas trade instead of the widely applied non-cooperative approach and distinguishes itself from other applied studies in the area.

In this study I employ the disaggregated quantitative model presented in Hubert & Cobanli (2012) and Hubert & Orlova (2012). The Eurasian gas network is represented by set of nodes R and links L. A link $l = \{i, j\},\ i \neq j \in R$ connects the node i with j. A typical player consist of four nodes. Production field R_P, LNG regasification plants R_{LNG} and consumer market R_C are linked to transit node R_T.[7] Players' transit nodes are connected with links to each other, which represent the international pipeline network. A positive x_{ij} designates gas flow from the node i to j through the link l_{ij}, while a negative value describes a flow to the opposite direction. Gas flow trough the link l_{ij} is constrained by the link's capacity k_{ij} and is subject to a link specific piecewise linear transportation cost $T_{ij}(x)$ which depends on the volume of gas shipped. Since flows from production node R_P and LNG node R_{LNG} to transit node R_T and flow from transit node R_T to consumption node R_C indicate production, LNG imports and consumption, respectively, they have to be positive ($x_{ij} \geq 0,\ \forall\, i \in R_P$ or $i \in R_{LNG}$ or $j \in R_C$). The inverse demand is denoted as $p_j(x_{ij})$.

A player's power is not solely determined by size of its consumer market, production and pipeline capacities, but by how these interact with other players' characteristics. In the cooperative approach, the value function captures the interaction among the players. N refers to the set of strategic players. The value function $v : 2^{|N|} \rightarrow R_+$ assigns a maximal surplus, i.e., value, to each possible coalition of the players $S \subseteq N$ with respect to flows through links x_{ij}. The regulatory framework determines the set of links, thus consumer markets, production fields, LNG facilities and international pipeline network, which a subset of players S can use. Hence, the value function reflects most important features of the Eurasian gas trade such as the pipeline network, the regulatory frame work, demand for gas, production capacities, transportation cost via different routes, etc. The value function is calculated as:

$$v(S) = \max_{\{x_{ij} | \{i,j\} \in L(S)\}} \left\{ \sum_{\{i,j\} \in L(S),\ j \in R_C} \int_0^{x_{ij}} p_j(z) dz - \sum_{\{i,j\} \in L(S)} T_{ij}(x_{ij}) \right\} \tag{1}$$

subject to the node balancing constraints at each transit node $\sum_i x_{it} = \sum_j x_{tj},\ \forall\, t \in R_T(S)$, the capacity constraint at each link $|x_{ij}| \leq k_{ij},\ \forall\, \{i, j\} \in L(S)$ and non-negativity constraints at production, consumption and LNG links $x_{ij} \geq 0,\ \forall\, i \in R_P$ or $i \in R_{LNG}$ or $j \in R_C$.

Then, from the value function the Shapley value derives the power structure in the Eurasian gas trade. It takes weighted average of a player's marginal contribution to

[7]Norway is composed of only production and transit nodes since it has no LNG imports and its consumption is negligible

each possible coalition; i.e., increase in the coalition's value by the player's incorporation. The Shapley value ϕ_i of a player $i \in N$ is simply calculated as:

$$\phi_i(v) = \sum_{S:i \notin S} P(S)\,[v(S \cup i) - v(S)] \tag{2}$$

where $P(S) = |S|!\,(|N| - |S| - 1)!/|N|!$ is the weight of coalition S.

There are several reasons which favor the Shapley value to other solution concepts applied in the cooperative game theory. Its definition is intuitive. The player adds value to the coalition by providing it access to new production fields, consumer markets, pipelines, etc. Thus, the Shapley value, also called (bargaining) power in this paper, allocates the surplus from cooperation within the players by considering how they complement with each other. Once the value function is calculated, the calculation of the Shapley value is easy and straightforward. It is convenient for policy analysis and decision making since it gives a unique solution and exists always.[8]

Proposing new pipeline projects, the players aim to amend the power structure in the Eurasian gas trade to their benefit. Since the value function reflects the pipeline network, a change of the pipeline network through a pipeline project alters the value function and thus, the Shapley value as well. The change in a player's Shapley value gives the project's gross impact on the player's power.

The set of players considered in the model covers a large geography ranging from UK to China. In Central Asia Kazakhstan, Turkmenistan and Uzbekistan are examined in detail. In the Middle East Iran is taken into consideration, since it is a potential supplier and a transit country for Turkmenistan's gas flowing westwards. Turkey is a major consumer and an emerging transit country in the East-West gas trade. Russia and Norway are the major non-European suppliers to European markets. Ukraine and Belarus, which depend totally on Russia to meet their demand, are the transit countries for Russian and partly Central Asian gas flowing to the European markets. I leave out the North African exporters Algeria and Libya since they have minor strategic importance for Central Asian gas. Although the EU's members have considerably different import dependency characteristics and contradictory energy policies, I combined them in three players: the Balkans, Continental Europe, and UK. I consider the Balkans composed by Bulgaria, Greece and Romania as a player since the poor pipeline connections isolate it from the rest of the European markets.

[8]For more details about alternative solutions concepts in cooperative game theory, such as core, kernel and nucleolus, see Myerson (2004) and Peleg & Sudholter (2007).

Table 3: Players

Regions	Consumption [bcm]		Production [bcm]		LNG Capacity [bcm]		Import Dep.[a] [%]	
	2009[b]	2015[c]	2009[bd]	2015[e]	2009[f]	2015[g]	2009	2015
Azerbaijan	10.	11.	14.9	20.	–	–	–	–
Kazakhstan	22.9	40.	27.2	47.	–	–	–	–
Turkmenistan	18.6	29.	38.3	85.	–	–	–	–
Uzbekistan	51.8	64.	65.6	72.	–	–	–	–
Balkan	20.2	22.7	10.8	10.8	5.3	7.3	46.5	52.4
Cont. Eur.	341.	383.7	121.8	125.8	43.7	84.5	64.3	67.2
UK	90.5	101.8	62.1	37.	51.1	51.1	31.4	63.7
Turkey	36.4	40.9	0.7	0.7	12.2	12.2	98.1	98.2
Russia	426.4	467.	550.5	679.	–	–	–	–
Ukraine	53.3	60.	21.9	21.9	0	0	58.9	63.5
Belarus	17.9	20.1	0.2	0.2	0	0	98.9	99.
Iran	136.5	136.5[h]	137.4	137.4[i]	–	–	–	–
Norway	6.	–	106.3	109.	–	–	–	–
China	89.2	197.	82.1	135.	12.6	44.4	8.	31.5

[a]Net imports/Consumption

[b]The data are compiled from IEA (2010b) and IEA (2011a).

[c]IEA (2010a) provides a detailed study of future consumption in Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan. The figures for China and Russia are taken from IEA (2011b). The same study forecasts that European demand will increase by 12.5% from 2009 to 2015. Therefore, consumption of European countries, Belarus, Ukraine and Turkey in 2009 are multiplied by 1.125.

[d]The data are compiled from IEA (2010b) and IEA (2011a). Exports to countries which are left out in the geographical scope are deducted from figures.

[e]IEA (2010a) provides production levels in Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan. Figures for China, Iran, Netherlands, Norway, Russia and UK are taken from IEA (2011b). The same study forecasts that the production in other European countries will remain unchanged from 2009 to 2015. I extend the same assumption to Belarus, Ukraine and Turkey.

[f]The data are compiled from GIE (2010). LNG capacities of China are taken from Higashi (2009).

[g]The data are compiled from GIE (2011). LNG capacities of China are estimated from Higashi (2009).

[h]Assumed equal to the consumption in 2011 although IEA (2011b) projects an increase of 17.2% in Middle East's demand.

[i]Assumed equal to the production in 2011 although IEA (2011b) forecasts 137 bcm.

Germany, Benelux countries, France, Italy, Poland, Switzerland, Denmark, Austria, Czech Republic, Slovenia and Hungary are collected under "Continental Europe". In Continental Europe only Netherlands is a net exporter, while other countries depend on imports from Norway, Russia, North Africa and LNG. Iberian Peninsula, the Baltic states and Scandinavia are left out.[9]

[9]Spain and Portugal satisfy their demand from LNG and North African suppliers, and the link between Spain and France has a small capacity (4.7 bcm/a). Baltic states and Scandinavia have negligible production and consumption. Both do not position strategically with respect to any pipeline project considered in this study.

While demand level, production and transit capacities as well as costs determine the amount of total surplus generated by cooperation in international gas trade, the share of surplus the players get depends on who has access to these. The EU's internal market regulation promotes that third parties can freely access the international trunk pipeline network in the EU to ship gas between markets, and the European players cannot draw benefits from blocking gas shipments through their pipeline network (EC, 2003, 2005, 2009). In the Non-EU area access to international pipeline network depends on the owner's permission. All players control their production, consumption and LNG facilities exclusively. Thus, they can prevent third parties from entering their consumer markets and using domestic gas supplies.

I follow Hubert & Ikonnikova (2011) to distinguish between the short- and far-sighted views. Here I report the results for the short sighted view of 2-3 years, which are long enough to make pipelines bidirectionally and to ignore seasonal effects of demand, but too short to undertake investments such as new pipeline links and enlargement of existing capacities. The short-sighted view focuses on the impact of each pipeline project in isolation and forgoes benefits from options to invest in other pipeline projects. Later, in section 5.1 I allow for investment options in the pipeline projects and check the robustness of my results with respect to this assumption.

Data for production, consumption and LNG imports in 2009 is compiled from IEA (2010b), IEA (2011a) and GIE (2010) to create the database necessary for the calibration of the model. Gas trade flows at the European border points in the same year is collected from IEA (2010b) and are used as benchmark for the calibration. Since the pipeline projects studied in this paper are expected to be inaugurated earliest in 2015, I projected the production, consumption and LNG figures in 2009 to 2015 by using forecasts of IEA (2010a), IEA (2011b), GIE (2011) and Higashi (2009). The Table 3 presents assumptions and their sources in more detail.

I work with linear demand functions and assume the same demand intercept for all consumers since there is poor information about demand functions. Thus, demand of several players can be aggregated easily, and the players are differentiated simply by the relation of their consumption to indigenous production. I assume piecewise linear, constant cost for production and make minor adjustments for different producers since it is hard to get reliable information about producers' wellhead production cost. So, differences between the suppliers rely on their production capacities and access to markets. Then, given the consumption in 2015 and the assumptions on the demand intercept and production cost, the slope parameters are estimated. Appendix A presents the numerical calibration of the model in detail.

The calibration of the model implies that the international pipeline network as existing in 2015 is sufficient for the westbound international gas trade. Given the willingness to pay of consumers and the production and transport costs of gas, it has enough capacity to carry gas efficiently from Russia and the Central Asian countries to the markets in Europe and Turkey. A central planner, or the grand coalition composed by all players would not invest in any of the pipeline projects heading from the East to the West. The pipeline projects running from the East to the West do not increase surplus, but they alter the distribution of surplus within the players.

4 Results for Pipelines

The section presents the pipeline options' impact on the players' bargaining power in detail. First, I examine the Central Asian countries' choice to undertake the Turkmenistan-China pipeline instead of a westbound option. Then, I analyze how the Turkmenistan-China pipeline alters the interaction between the West and the East. Later, in the presence of the Turkmenistan-China pipeline I compare the benefits accruing from each westbound pipeline option to the Central Asian countries.

4.1 East vs. West

The situation before the inauguration of the Turkmenistan-China pipeline is shown in Table 4. In this case, the Central Asian countries have not yet decided on the pipeline option, east- or westbound, they will undertake. Column 1 presents the benchmark and displays the distribution of the total surplus among the players. The other columns show each pipeline option's impact on the players' bargaining power in differences with respect to the benchmark. All the figures are given in annualized absolute terms, bn €/a (billion Euros per annum).

The benchmark shows that the Central Asian countries acquire a very small share of the surplus (in total 0.3 bn €/a) since they rely on Russia and partly on Iran to ship their gas westwards to Europe and Turkey. Russia's Gazprom controls the CAC pipeline system, which connects the Central Asian countries with each other and Russia's pipeline network, and Russia has enough spare production capacity to satisfy the European and Turkish demand in the absence of the Central Asian countries. However, in the West of the Caspian Sea, Azerbaijan has a relatively high surplus (1.1 bn €/a) since it diversified its transport routes via SCP and gained access to Turkey and the Balkans. Since in this scenario the Turkmenistan-China

Table 4: The Central Asian countries' pipeline options: Impact on the bargaining power [bn €/a]

Players	Bench-mark[b]	Impact of pipelines (difference to column 1) to the East: Turkm. -China	to the West: Southern Corridor[a] via Caspian +TCP	Southern Corridor[a] via Iran +TTP	via Russia: South Stream
Azerbaijan	1.1	0.	1.2	0.5	−0.2
Kazakhstan	0.1	0.5	0.	0.	0.
Turkmenistan	0.2	0.5	0.5	0.3	0.
Uzbekistan	0.	0.5	0.	0.	0.
Balkan	1.3	0.	0.1	0.1	0.3
Cont.Eur.	32.2	0.	0.3	0.3	1.3
UK	12.6	0.	0.1	0.1	0.3
Turkey	14.3	0.	1.2	1.5	0.3
Russia	30.7	0.	−1.8	−2.1	1.9
Ukraine	15.3	0.	−0.5	−0.5	−2.
Belarus	10.8	0.	0.	0.	−0.4
Iran	1.9	0.	−0.3	0.6	−0.3
Norway	19.8	0.	−0.6	−0.7	−1.3
China	0.	0.5	0.	0.	0.
project cost[c]		1.4	1.7	2.7	2.3

[a]The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b]The Turkmenistan-China pipeline is not in operation yet. China is not connected to the Eurasian gas trade via pipelines.

[c]Investment cost annualized with an interest of 15%.

pipeline is not in operation yet, there is no pipeline linking China to the Eurasian gas trade, thus no trade of pipeline gas. Therefore, China gains no surplus although it is a major consumer.

Column 2 in Table 4 introduces the Turkmenistan-China pipeline to the pipeline network. According to the projections for its demand, production and LNG capacities in 2015, China needs at least 22.6 bcm/a of pipeline gas to meet its domestic demand (See Table 3).[10] Therefore, the Turkmenistan-China pipeline has an economic impact in addition to its strategic effect, and the grand coalition's surplus increases by 1.8 bn €/a to 1219.3 bn €/a. The gains from the project is equally

[10]In Section 5 I increase China's demand in 2015 from 197 bcm to 230 bcm and analyze the impact of the strong demand growth in China on the westbound pipeline projects and the power distribution in the Eurasian gas trade.

distributed among the members of its consortium; i.e., the Central Asian countries and China. Each of them benefits 0.5 bn €/a from the project. The consortium's total gain sums up to 2. bn €/a, which is enough to cover the project's cost, 1.4 bn €/a.[11] All other players' surplus remains unchanged. Due to the ample production capacities in Central Asia, there is no strategic interaction between the East and the West. This finding explains why Russia and Europe took little interest in the Turkmenistan-China pipeline.

Columns 2-5 in Table 4 show that altogether the Central Asian countries gain 1.5 bn €/a from the Turkmenistan-China pipeline while the most profitable westbound option, i.e., via the Caspian Sea, yields only a benefit of 0.5 bn €/a to them. These figures are in line with the Central Asian countries' decision to endorse the Turkmenistan-China pipeline instead of a westbound option. For Turkmenistan the westbound option via the Caspian Sea (0.5 bn €/a) would be as beneficial as the Turkmenistan-China pipeline (0.5 bn €/a).

4.2 West: Pipeline Contest

Now I look into the current state of the Eurasian pipeline game. The Turkmenistan-China pipeline is in place and serves Central Asian gas to the Chinese market. None of the westbound pipeline options (i.e., via the Caspian Sea, via Iran and via Russia) is built, and they compete for the transit of westbound Central Asian gas. Columns 5-7 in Table 5 present the westbound pipeline options' impact on the bargaining power structure in presence of the Turkmenistan-China pipeline. The figures are the same as in columns 3-5 of Table 4, where the Turkmenistan-China pipeline is absent. The introduction of the Turkmenistan-China pipeline does not alter the westbound pipeline options' impact since Turkmenistan has large spare production capacities and can serve demand of the West as well as the East simultaneously. At the present capacity levels there is no demand competition for Central Asian gas between Europe and China.

4.2.1 The Southern Corridor

The Shah Deniz consortium's decision in June 2013 set the final route for the Southern Corridor. First, Azerbaijani gas will be carried through TANAP to the Turkey-EU border and then, from there through TAP to the Central European markets. Later,

[11] If the Second West-East pipeline's cost is included, the total cost increases to 2.4 bn €/a, and the Turkmenistan-China pipeline becomes strategically unviable.

Central Asian gas may be delivered through the pipeline projects via the Caspian Sea (TCP) or via Iran (TTP) to the Southern Corridor if the obstacles hindering the projects' construction can be solved in the near future.

Following the same scheme, first, columns 2-4 in Table 5 present the Southern Corridor's impact on the bargaining power structure. TAP's former rival, Nabucco-West is presented in Table 5 as well to clarify the Shah Deniz Consortium's recent choice of TAP rather than Nabucco-West. Then, columns 5 and 6 in Table 5 display the impact of linking the Central Asian countries to the Southern Corridor via the Caspian Sea or via Iran, respectively.

TANAP

TANAP delivers Azerbaijani gas to the markets in Turkey and the Balkans. As presented in column 2 of Table 5, the initiators of the project, Azerbaijan and Turkey gain 0.6 bn €/a each. While Turkey enjoys supply competition in its market, Azerbaijan profits from better access to the consumer markets. Supply competition with Azerbaijan in Turkey as well as the Balkans hurts the dominant supplier, Russia and its transit country Ukraine by -0.6 and -0.3 bn €/a, respectively. The project alters the European players' power marginally since the poor pipeline capacities between the Balkans and Central Europe prevent access of Azerbaijani gas to the major European markets. TANAP is strategically viable for its consortium since their total gain (1.2 bn €/a) surpasses the project's cost (0.7 bn €/a).[12] The project's construction is expected to start in 2014.

Nabucco-West vs. TAP

Although TAP and Nabucco-West follow different routes, they both eliminate the bottleneck between the Balkans and Central Europe with a capacity of 10 bcm/a and carry Azerbaijani (as well as Central Asian) gas to the major European markets. If the projects would have the same third party access regime, they would impact the players' bargaining power exactly in the same way. However, their third party access regimes are different.

[12]Remember that TANAP's consortium is composed by Azerbaijan, Turkey and the Shah Deniz field's investors. I regard the Shah Deniz field's consortium as consisting of UK and Azerbaijan since they are the major stakeholders.

Table 5: The Central Asian countries' westbound pipeline options: Impact on the players' bargaining power [bn €/a]

		Impact of pipelines (difference to column 1)					
					to the West		
		Southern Corridor			Southern Corridor[a]		via Russia
	Bench-mark[b]	TANAP	TANAP +NabW[c]	TANAP +TAP[d]	via Caspian +TCP	via Iran +TTP	South Stream
Azerbaijan	1.1	0.6	0.5	0.7	1.2	0.5	−0.2
Kazakhstan	0.6	0.	0.	0.	0.	0.	0.
Turkmenistan	0.7	0.	0.	0.	0.5	0.3	0.
Uzbekistan	0.5	0.	0.	0.	0.	0.	0.
Balkan	1.3	0.1	0.2	0.	0.1	0.1	0.3
Cont.Eur.	32.2	0.	0.	0.2	0.3	0.3	1.3
UK	12.6	0.	0.	0.	0.1	0.1	0.3
Turkey	14.3	0.6	1.1	0.7	1.2	1.5	0.3
Russia	30.7	−0.6	−0.6	−0.6	−1.8	−2.1	1.9
Ukraine	15.3	−0.3	−0.8	−0.5	−0.5	−0.5	−2.
Belarus	10.8	0.	0.	−0.1	0.	0.	−0.4
Iran	1.9	−0.2	−0.3	−0.2	−0.3	0.6	−0.3
Norway	19.8	−0.2	−0.1	−0.4	−0.6	−0.7	−1.3
China	0.5	0.	0.	0.	0.	0.	0.
project cost[e]	–	0.7	1.5	1.2	1.7	2.7	2.3

[a] The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b] The Turkmenistan-China pipeline is in operation and serves Central Asian gas to Chinese markets.

[c] Half of Nabucco-West's capacity is exempt from the EU's third party access regulation. Only half of the pipeline's capacity is open to the third party access. Other half of the capacity is reserved for the coalitions containing Azerbaijan and Continental Europe.

[d] TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[e] Investment cost annualized with an interest of 15%.

While half of Nabucco-West's capacity (5 bcm/a) is open for all players in both directions, the other half of the capacity is reserved only for coalitions containing Azerbaijan and Continental Europe. While Azerbaijan enters to the Western and Central European markets, Norway and Netherlands gain access to the markets in Turkey and the Balkans. Thus, the supply competition strengthens on both sides of the bottleneck. Comparison of columns 2 and 3 in Table 5 displays the impact of the Southern Corridor's extension via Nabucco-West. Turkey benefits by 0.5 bn €/a from its transit position between Azerbaijan and Europe as well as from the access of Norway and Netherlands to its market. Surprisingly, Nabucco-West harms Azerbaijan by 0.1 bn €/a and brings no benefits to Continental Europe. Azerbaijan gains from access to the European markets, but supply competition with Norway and Netherlands in Turkey and the Balkans wipes out its gains. Similarly, Continental Europe gains from stronger supply competition in Europe, but it suffers from demand competition with Turkey and the Balkans for Dutch and Norwegian supplies. With 0.5 bn €/a the total gain accruing to Nabucco West's consortium (composed of Continental Europe, Balkan, Turkey, Azerbaijan and UK) falls short of the project's cost, 0.8 bn €/a. A major share of the gains is collected by the transit country, Turkey, instead of the consumer, Europe and the supplier, Azerbaijan. Considering the low benefits accruing to the European players, the analysis suggests that European companies would not invest in Nabucco-West. In line with this conclusion, Germany's RWE left Nabucco-West's consortium in April 2013. However, France's GDF Suez joined it in May of the same year.

TAP's full capacity is exempt from the European third party access regulation. Azerbaijan and Continental Europe may derive bargaining power by blocking access of Norway and Netherlands to the markets in Turkey and the Balkans. Thus, the supply competition intensifies only in the West of the bottleneck. Comparison of columns 2 and 4 in Table 5 displays the impact of the Southern Corridor's extension by TAP. Turkey and the Balkans benefit only from their transit position on the route, but these gains are wiped out by demand competition with the European consumers for Azerbaijani supplies. While Azerbaijan gains by 0.1 bn €/a from access to the European markets, its market share in Turkey and the Balkans are guarded against supply competition with Norway and Netherlands. In Continental Europe the consumers enjoy supply competition and are protected from demand competition with Turkey and the Balkans. With 0.2 bn €/a benefits to the TAP's consortium (composed of Continental Europe, the Balkans, Azerbaijan and UK) remain below the project's cost, 0.5 bn €/a. As a matter of fact, TAP's consortium plans to commence the project's construction in 2015. The model seems to underestimate benefits accruing to the project's consortium.

Considering the gains accruing to Azerbaijan and Continental Europe from TAP and Nabucco-West, the model suggests that the Shah Deniz field's consortium as well as the European consumers would favor TAP over Nabucco-West as the final route from the Turkey-EU border to the Central European markets. This conclusion is in consonance with the Shah Deniz consortium's recent decision in favor of TAP to deliver westbound Azerbaijani gas.

4.2.2 Via the Caspian Sea (TCP)

TCP carries Central Asian gas via an offshore pipeline under the Caspian Sea to its western coast, and from there the Southern Corridor (TANAP and TAP) delivers the gas to the Turkish and European markets. Comparison of columns 4 and 5 in Table 5 displays the impact of connecting the Central Asian countries via TCP to the Southern Corridor. Turkmenistan benefits by 0.5 bn €/a since TCP bypasses the current transit countries, i.e., Russia and Iran, and introduces a new transport route for westbound Central Asian gas. The power of Kazakhstan and Uzbekistan remains unchanged. They rely on Turkmenistan to access to TCP, and Turkmenistan's spare production capacity is more than enough to fill up the offshore pipeline's capacity. Turkey enjoys supply competition in its market as well as its transit position on the route (0.5 bn €/a). The suppliers serving the Turkish and European markets such as Russia, Iran and Norway suffer from supply competition with Turkmenistan. However, Azerbaijan benefits from Turkmenistan's access to its export markets (0.5 bn €/a) since it is the transit country on the route and controls Turkmenistan's access to the Southern Corridor. Although the EC supports TCP, Turkmen gas via TCP returns the European players (i.e., the Balkans, Continental Europe and UK) only 0.3 bn €/a due to the transit countries on the route, and the European companies show little interest in the project. This finding implies that the EC may have overestimated TCP's strategic impact on the European players. Costing 0.5 bn €/a, TCP is strategically viable for the non-European countries Turkmenistan, Azerbaijan and Turkey (1.5 bn €/a in total). Although Turkey has expressed its interest in Turkmen gas, the long-lasting dispute between Azerbaijan and Turkmenistan over the Kyapaz field in the Caspian Sea as well as the Russian and Iranian opposition hinder the project's construction.

In Table 5, firstly, the Southern Corridor (TANAP and TAP) carries Azerbaijani gas to the Turkish and European markets (column 4). Then, TCP connects Turkmenistan to the Southern Corridor (column 5). Table B.1 in Appendix B presents a counterfactual scenario: firstly, TCP and TANAP link Turkmenistan to the markets in Turkey and the Balkans (column 2). Then, Nabucco-West or TAP transits the gas to the Central European markets (columns 3 and 4, respectively). A comparison of columns 2 and 4 shows that Turkey is Turkmenistan's main export market on the route. Access to Turkey yields Turkmenistan a benefit of 0.5 bn €/a. A link to the major European markets, i.e., TAP or Nabucco-West, brings no additional benefits to Turkmenistan.

4.2.3 Via Iran (TTP) and the Southern Corridor

Comparison of columns 4 and 6 in Table 5 displays the impact of linking Turkmenistan via Iran to the Southern Corridor. TTP benefits Turkmenistan by 0.3 bn €/a. Again, the transit countries, in this case Turkey and Iran, collect most of the gains from the project. While Turkey enjoys supply competition in its market, Iran benefits from better access to the markets. TTP affects the rest of the players in an analogous manner to TCP (see section 4.2.2.). The project is strategically viable for its consortium composed by Iran and Turkey since their total gain (1.6 bn €/a) exceeds the project's investment cost of 1.5 bn €/a. However, the western opposition to Iran's involvement in the Eurasian gas trade obstructs investment in the project.

The options via the Caspian Sea (TCP) and via Iran (TTP) both carry same volumes of Central Asian gas (15 bcm/a) to the Southern Corridor. I compare columns 5 and 6 in Table 5 to deduce the most beneficial westbound option for the Central Asian countries. While the option via Iran extends only the existing capacities, the option via the Caspian Sea adds a new third transport route to the pipeline network. Therefore, for Turkmenistan the option via the Caspian Sea is more beneficial. Both options increase supply competition between Azerbaijan and Turkmenistan in the Balkans and Turkey. Since Azerbaijan is a transit country for Turkmen gas on the option via the Caspian Sea, the supply competition is weaker.

4.2.4 Via Russia

South Stream connects Russia via an offshore pipeline under the Black Sea to the Balkans. From there, the onshore pipeline carries Russian (as well as Central Asian) supplies to the Central European markets. Column 7 in Table 5 shows that South Stream has no impact on the Central Asian countries' bargaining power since it preserves the status quo in the westbound transit of Central Asian gas. The

Central Asian countries still rely on Russia to ship their gas to Europe and Turkey, and in their absence Russia's production capacity is enough to serve the demand in these markets. While the bypass of the transit countries benefits Russia by 1.9 bn €/a, transit competition harms Ukraine by 2. bn €/a. South Stream strengthens Russia's dominance in the western markets and hurts the suppliers serving Europe and Turkey. Although the EC regards the project with skepticism, it benefits Continental Europe by 1.3 bn €/a. Relying on Russian supplies transported through Ukraine, Turkey and the Balkans gain 0.3 bn €/a each from the offshore pipeline. Large benefits accruing to Russia and Continental Europe are enough to cover the project's cost of 2.3 bn €/a. In line with this conclusion, Russia and its partners commenced South Stream's construction in December 2012. Hubert & Cobanli (2012) studies South Stream's impact on the European players in detail.

European concerns or Russian expectations that South Stream may preempt investment in the route via the Caspian Sea (Southern Corridor and TCP) are unfounded. Table B.2 in Appendix B presents the impact of the route via the Caspian Sea on the players' bargaining power in the absence and the presence of South Stream. Comparison of columns 2 and 3 with columns 5 and 6 shows that South Stream's presence alters gains from the opening of the route via the Caspian Sea only slightly. South Stream and the route via the Caspian Sea benefit Europe and Turkey through different effects. While South Stream intensifies transit competition for westbound Russian gas by bypassing Ukraine, the route via the Caspian Sea increases supply competition in Europe and Turkey by introducing new suppliers, i.e., Azerbaijan and Turkmenistan.

5 Robustness

5.1 Investment Options

I follow Hubert & Ikonnikova (2011) and employ the far-sighted view to consider the option value of investment in the pipeline projects. In this case, the pipeline network becomes more flexible, and the model allows for optimal investment in the pipeline projects. The far-sighted view ignores the time necessary to implement a project and assumes that a project can be undertaken immediately. Due to the calibration of the model, the grand coalition consisting of all players would not invest in any of the westbound pipeline projects since they do not create any value, but smaller coalitions of the players may invest in the pipeline projects crossing through their territory or extend their capacities further if they have been undertaken already.

Comparison of Table 4 in Section 4 with Table C.1 in Appendix C displays the impact of investment options on the players' bargaining power. In the far-sighted view the total surplus in the base case is 0.9 bcm/a larger than in the short-sighted view. Since in the base case China is not linked to the Eurasian gas trade, the grand coalition invests in the Turkmenistan-China pipeline to serve China's demand for pipeline gas and creates value. While Russia, Ukraine, Belarus and Norway receive smaller shares of power, the shares of all other players increase. The importers are less captured by the traditional suppliers and transit countries. In smaller coalitions the alternative suppliers and the importers invest in the projects to improve their bargaining power. In the far-sighted view the pipeline projects' impact on the bargaining power has the same sign as in the short-sighted view, but it is smaller in magnitude. The value of investment option in a project is already considered in the base case. Therefore, when the project is in place, its impact with respect to the base case is smaller. Thus, the conclusions regarding the pipeline projects' impact on the players' bargaining power are robust with respect to the option value of investment. See Table 5 in Section 4 and Table C.2 in Appendix C for the impact of the investment options on the westbound pipeline projects.

5.2 High Demand in China

In subsection 4.1, China's demand for pipeline gas does not exploit the total capacity of the Turkmenistan-China pipeline (30 bcm/a). It is assumed that increase in China's indigenous production and LNG regasification capacities serves the bulk of its demand. However, China signed several long term contracts with the Central Asian states and plans to extend the Turkmenistan-China pipeline's capacity by 25 bcm/a (Platts, 2013). I increase China's expected demand in 2015 from 197 bcm to 230 bcm and check the robustness of my results with respect to this strong demand growth. In this case, Chinese appetite for pipeline gas (at least 55.6 bcm) exceeds the capacity of the Turkmenistan-China pipeline.

Tables D.1 and D.2 in Appendix D can be compared with Tables 4 and 5 in Section 4 to study the impact of the strong demand growth in China. Increase in Chinese demand for pipeline gas enhances the gains of China and the Central Asian states from the Turkmenistan-China pipeline remarkably from 0.5 bn €/a to 1.9 bn €/a for each and from 2. bn €/a to 7.6 bn €/a in total. However, the bargaining power of the players in the West of the Caspian Sea and the impact of the westbound pipeline options on the bargaining power distribution are affected marginally since the Central Asian states have enough production capacity to serve the Turkmenistan-China pipeline as well as the markets in the West.

5.3 Demand Intercept

The selection of demand intercept is critical for the conclusions about the strategic viability of the pipeline projects. The difference between the demand intercept and the production cost determines the total surplus from the international gas trade. The overall surplus of the grand coalition and thus, the absolute shares of the players increase with the intercept while the relative shares of the players remain robust. In this study, an estimate of 1500 mn (million) €/bcm is used for the difference between the demand intercept and the production cost. I checked robustness of my results for a relatively conservative estimate of 500 mn €/bcm.

Such a reduction decreases the total surplus of the grand coalition from 1219.3 bn €/a to 429. bn €/a in the baseline variant when the Turkmenistan-China pipeline is in operation. A comparison of Tables 4 and 5 in Section 4 with Tables E.3 and E.4 in Appendix E shows that the projects' impact in absolute terms decreases proportionally with the demand intercept. Therefore, none of the pipeline projects considered in this study are strategically viable in absolute terms. A comparison of Tables E.1 and E.2 with Tables E.5 and E.6 in Appendix E displays that the projects' impact in relative terms differs marginally.

6 Concluding Remarks

Using cooperative game theory, I have analyzed the strategic impact of the selected pipeline projects on the bargaining power of the players in the Eurasian gas trade. Four major pipeline options compete for diversification of the Central Asian countries' transit routes as well as export markets. While the Turkmenistan-China pipeline extends eastwards to rapidly growing China, three options head westwards to Europe and Turkey: via the Caspian Sea, via Iran and via Russia.

Bringing larger gains than the western options, the Turkmenistan-China pipeline is the best diversification option for the Central Asian countries. Given the slack production capacities in Turkmenistan and the proposed pipeline capacities, I do not observe serious demand competition for Central Asian gas between China and the West. The Turkmenistan-China pipeline does not alter the power distribution in the West of the Caspian Sea, and it has no impact on the strategic viability of the westbound pipeline projects.

For Turkmenistan the route via the Caspian Sea is the most beneficial westbound option since it bypasses the transit countries, i.e., Russia and Iran, and introduces a new transport route for westbound Central Asian gas. The Iranian route enlarges the existing capacities. Thus, increase in transit competition for Central Asian gas is limited. Contrary to the EC's expectations, supplies from Turkmenistan and Azerbaijan benefit the European players marginally. Turkey emerges as a transit country and collects most of the benefits from the projects.

South Stream, Russia's flagship project, alters the power structure to the advantage of Russia and Europe while it maintains the status quo for the Central Asian countries. Contrary to the EC's skepticism, diversification of the transit routes carrying Russian supplies to the European markets returns European consumers large benefits. South Stream fails to preempt investment in the Southern Corridor and TCP since the projects benefit Europe and Turkey through different effects: transport and supply competition, respectively.

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A Technical Appendix

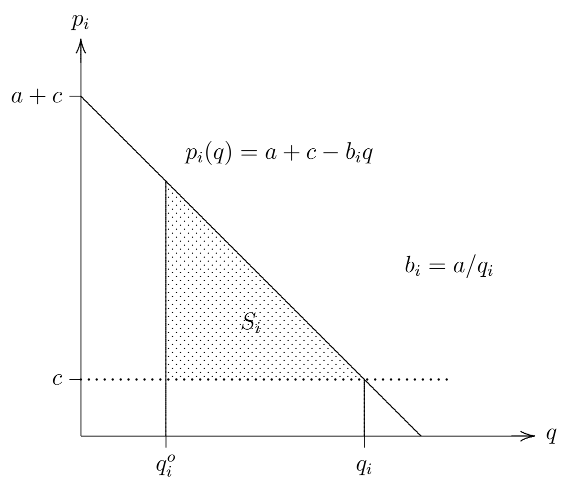
A.1 Calibration

This section describes the functions and parameters used for the calculation of the value function (equation (1) in the main text). The calibration of the model shares the same approach with Hubert & Cobanli (2012) and Hubert & Orlova (2012). Let $x^*_{ij},\ \{i, j\} \in L(N)$ denote the solution to the program in (1) when solved for the grand coalition, which has access to all resources. To calibrate the model, p_i and T_{ij} have to be determined such that x^*_{ij} are reasonably close to observed consumption and flows. As it is assumed that the players cooperate effectively, they will make efficient use of the existing network. Hence, for each player the marginal willingness to pay for gas, $p_i(q)$ will be equal to the local marginal cost of supplying gas, i.e., the nodal cost $c_i(q)$, which take into account the physical constraints of the system. This feature is used to calibrate first inverse demand and then supply cost using data on consumption and flows.

A.1.1 Demand

Transport costs within Europe are small compared to the cost of producing gas and transporting it to Europe's borders. As a first approximation, the small differences among local costs are neglected, and a common constant supply cost c is assumed. When the program is solved for the grand coalition, none of the links within Europe are capacity constrained. So, nodal costs differ only by the variable transportation cost between connected nodes which are small.

Figure 2: The Surplus (S_i)



Each consumption node's willingness to pay for gas is represented with a linear inverse demand function. To reduce the number of parameters, for all consumption nodes the same intercept $a + c$ is assumed. Efficiency requires $p_i(q) = a + c - b_i q = c$ for each consumption node i. The slope parameters b_i are then calibrated as to replicate the consumption in 2015: $b_i = a/q_i$, where q_i is the consumption of gas in the consumption node i. As illustrated in Figure 2, the surplus, which a player obtains from participating in the trade of pipeline gas, depends on the three parameters: the difference between the demand intercept and the common supply cost a, its consumption in the base year q_i, and its indigenous production q_i^o. The common supply cost c acts as a shift parameter, which does not affect the surplus.

A change of a, with b_i being adjusted, affects all players proportionally. Such a change has little impact on the *relative* Shapley value (measured in percent of the total), hence, will have little effect on the relative index for bargaining power. However, a determines the absolute size of the surplus and thus, the *absolute* Shapley value, which is of relevance if the changes in bargaining power are compared to the cost of a pipeline project. It is difficult to support any assumption for a by hard data. Obviously, it will depend a lot on how much time customers are given to substitute to other sources of energy. Making a bold assumption, a is set equal to 1500 mn €/bcm yielding a total surplus from consuming gas of 1219.3 bn €/a in the baseline variant when the Turkmenistan-China pipeline is operation.

Data for consumption q_i in 2015 are compiled from various sources. IEA (2010a) provides a detailed study of future consumption in Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan. The figures for China and Russia are taken from IEA (2011b). The same study forecasts that European demand will increase by 12.5% from 2009 to 2015. Therefore, consumption of European countries, Belarus, Ukraine and Turkey in 2009 are multiplied by 1.125. Data for consumption in 2009 are compiled from IEA (2010b) and IEA (2011a). See Table A.1 for the resulting values of the slope parameter b_i depending on a. All quantities are quoted in bcm/a. All prices or costs are quoted in mn €/bcm.

The parameter c acts as a shift parameter for the demand system and supposed to reflect the typical production and transportation cost. Accordingly, it is decomposed as $c = c^P + \bar{c}^T$, where c^P reflects a common production cost parameter and $\bar{c}^T$ an adjustment made for typical transportation cost. These values determine the patterns of production and transport which are presented next.

Table A.1: Pipeline Network: Consumers

Consumption Nodes	Consumption [bcm/a] q_i	Slope: Baseline $a = 1500$ b_i	Slope: High Chinese Demand $a = 1500$ b_i	Slope: Low Surplus $a = 500$ b_i	Needed for Access
AzerbaijanC	11.	136.4	136.4	45.5	Azerbaijan
BelarusC	20.1	74.6	74.6	24.9	Belarus
ChinaC	197.	7.6	6.5	2.5	China
IranC	137.	10.9	10.9	3.6	Iran
KazakhstanC	40.	37.5	37.5	12.5	Kazakhstan
RussiaC	467.	3.2	3.2	1.1	Russia
TurkeyC	40.9	36.7	36.7	12.2	Turkey
TurkmenistanC	29.	51.7	51.7	17.2	Turkmenistan
UkraineC	60.	25.	25.	8.3	Ukraine
UzbekistanC	64.	23.4	23.4	7.8	Uzbekistan
BalkanC	22.7	66.	66.	22.	Balkan
BelgiumC	19.	79.	79.	26.3	Cont.Eur.[a]
CenterC	117.7	12.7	12.7	4.2	Cont.Eur.
Center-EastC	46.6	32.2	32.2	10.7	Cont.Eur.
FranceC	49.6	30.2	30.2	10.	Cont.Eur.
ItalyC	85.	17.6	17.6	5.9	Cont.Eur.
NetherlandsC	54.3	27.6	27.6	9.2	Cont.Eur.
PolandC	18.	83.4	83.4	27.8	Cont.Eur.
UKC	101.8	14.7	14.7	4.9	UK

[a] To reduce the number of players, Continental Europe (Cont.Eur.) stands for all European players except UK and Balkan.

A.1.2 Production

Data for production in 2015 are compiled from various sources. IEA (2010a) provides production levels in Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan. Figures for China, Iran, Netherlands, Norway, Russia and UK are taken from IEA (2011b). The same study forecasts that the production in other European countries will remain remain unchanged from 2009 to 2015. I extend the same assumption to Belarus, Ukraine and Turkey. Data for production in 2009 are collected from IEA (2010b) and IEA (2011a). Column 1 in Table A.2 presents the players' expected production in 2015. These can be compared to the production in 2009 as shown in column 2.

Table A.2: Pipeline Network: Production

Links from	Links to	Production in 2015 [bcm/a]	Production in 2009 [bcm/a]	Cost[a] $c_p + \Delta_i$ [mn €/bcm]	needed for access
Net Exporters					
AzerbaijanP	Azerbaijan	20.	14.9	$c_p - 5$	Azerbaijan
IranP	Iran	137.	137.4	$c_p - 16$	Iran
KazakhstanP	Kazakhstan	47.	27.2	$c_p + 1$	Kazakhstan
NorthSeaP	NorthSea	109.	99.4	$c_p - 7$	NorthSea
RussiaP	Russia	679.	550.5	c_p	Russia
TurkmenistanP	Turkmenistan	85.	38.3	$c_p + 3.4$	Turkmenistan
UzbekistanP	Uzbekistan	72.	65.6	$c_p + 1$	Uzbekistan
NetherlandsP	Netherlands	83.	78.7	$c_p - 4.4$	Cont.Eur.[b]
Net Importers					
BalkanP	Balkan	10.8	10.8	0.	Balkan
BelarusP	Belarus	0.2	0.2	0.	Belarus
BelgiumP	Belgium	0.	0.	0.	Cont.Eur.
Center-EastP	Center-East	4.9	4.9	0.	Cont.Eur.
ChinaP	China	135.	82.1	0.	China
FranceP	France	0.9	0.9	0.	Cont.Eur.
Center P	Center	23.7	23.7	0.	Cont.Eur.
ItalyP	Italy	8.1	8.1	0.	Cont.Eur.
PolandP	Poland	5.8	5.8	0.	Cont.Eur.
TurkeyP	Turkey	0.7	0.7	0.	Turkey
UKP	UK	37.	62.1	0.	UK
UkraineP	Ukraine	21.9	21.9	0.	Ukraine

[a] The global parameter c_p is set equal to 20. Production cost of the players, who are net importers, is set equal to zero. The unit cost is given for flows up to 75% of the capacity. For the remaining 25% of capacity the numbers are increased by 20%.

[b]To reduce the number of players, Continental Europe (Cont.Eur.) stands for all European players except UK and Balkan.

The differences in the production cost of existing fields are small compared to differences in the cost of developing new fields. Since meaningful information on wellhead production cost is difficult to obtain, a common supply cost parameter c^P is introduced. In accordance with Table 13.6 in IEA (2009), Δ_i accounts for regional differences in wellhead production cost and adjusts c^P for each player. For the players, who are net importers, cost of using their indigenous production is ignored. Since it is more difficult to produce at maximal capacity k_{ij}, production cost is assumed to be piecewise linear : $T_{ij}(q) = (c^P + \Delta_i)(\min[q, 0.75 * k_{ij}] + 1.2 \max[q - 0.75 * k_{ij}, 0])$. These adjustments help to get more realistic flows for the network, but have only a negligible impact on the estimate of bargaining power. Since the demand system is adjusted to any choice of c^P, its absolute value is rather irrelevant and arbitrarily set as $c^P = 20$ mn €/bcm. Column 3 in Table A.2 exhibits production cost of the players given c^P.

A.1.3 Transport

The total cost of transporting gas consists, in principle, of operating cost and capacity cost. Since capacity costs of existing pipelines are sunk, they are not taken into account. This simplification is based on the assumption that bargaining among rational players should not be influenced by sunk cost. The operating cost is composed by management & maintenance cost and energy cost, which are proportional to the length of the pipeline as well as to the quantity of gas transported. The operating cost is represented as a piecewise linear function: $T_{ij}(q) = c^T_{ij} * (\min[q, 0.75 * k_{ij}] + 1.2 * \max[q - 0.75 * k_{ij}, 0])$, where k_{ij} denotes maximal capacity. Per unit transportation costs are constant, but only up to three quarter of the pipe capacity and increased by 20% for the remaining quarter. Capacities of the pipelines linking the players' transit nodes are collected from ENTSOG (2010) and public sources. Data for flows in 2009 are collected from IEA (2010b) and IEA (2011a). Capacities of the pipelines which are connected to areas outside of the regional scope are limited to flows through them in 2009. The pipe capacities and the flows through them are presented in columns 1 and 2 of Table A.3, respectively.

To calculate the link specific cost parameter c^T_{ij}, for onshore pipelines universal operating cost of 0.3 mn €/bcm/100km is assumed. For offshore pipelines operating cost is 50% higher to account for higher pressure and increased difficulties of maintenance. These coefficients are then multiplied with the distance between the nodes to obtain the link specific operating cost as shown in Table A.3 column 3.

Having specified production cost by c^P and Δ_i, as well as link specific transportation cost by c^T_{ij}, the only free parameter is the 'typical' transport cost $\bar{c}^T$. To determine a value, the optimization program (1) is run for the grand coalition to find that $\bar{c}^T = 20$ mn €/bcm yields a solution x^*_{ij} which closely replicates the empirical data on consumption and flows in the system.

Table A.3: Pipeline Network: Transport

Links from	Links to	Capacity [bcm/a]	Flow [bcm/a]	Operation[a] Cost: c_{ij}^T [mn €/bcm]	needed for access
Transit outside EU					
Azerbaijan	RussiaS	13.	0.	3.8	Azerbaijan, Russia
Azerbaijan	TurkeyE	7.	4.5	2.4	Azerbaijan, Turkey
Iran	TurkeyE	13.7	7.2	1.2	Iran, Turkey
Kazakhstan	Russia	49.	0.	5.1	Kazakhstan, Russia
Kazakhstan	RussiaS	49.	32.3	3.6	Kazakhstan, Russia
Russia	Belarus	100.	49.2	2.1	Russia, Belarus
Russia	RussiaN	165.	0.	2.3	Russia
Russia	RussiaS	240.	8.9	2.1	Russia
Russia	UkraineE	415.	109.1	2.	Russia, Ukraine
RussiaN	Center	55.	0.	6.9	Russia
RussiaS	Turkey	16.	8.9	4.8	Russia, Turkey
RussiaS	UkraineE	200.	24.6	1.2	Russia, Ukraine
TurkeyE	Turkey	20.	11.8	2.4	Turkey
Turkmenistan	Iran	20.	5.8	2.3	Turkmenistan, Iran
Turkmenistan	Kazakhstan	5.	0.	2.7	Russia, Kazakhstan, Turkmenistan
Turkmenistan	Uzbekistan	44.	10.7	1.7	Russia, Turkmenistan, Uzbekistan
UkraineE	Ukraine	122.	95.1	2.5	Ukraine
Uzbekistan	Kazakhstan	44.	22.5	1.8	Russia, Kazakhstan, Uzbekistan
Transit into (out of) EU					
Balkan	Turkey	16.3	8.9	1.8	Turkey
Belarus	Poland	33.	31.3	1.4	Belarus
Norway	Belgium	15.	12.2	5.2	Norway
Norway	France	18.3	15.	5.9	Norway
Norway	Center	46.	29.2	5.2	Norway
Norway	UK	46.4	24.	4.9	Norway
UkraineE	Balkan	31.3	16.5	3.4	Ukraine
Ukraine	Center-East	105.8	77.	1.9	Ukraine
Ukraine	Poland	3.2	3.2	1.2	Ukraine
Transit within EU					
Belgium	France	30.	14.9	0.8	Free third party access to transit pipelines within the EU
Belgium	Center	26.	1.0	0.6	
Center-East	Balkan	1.7	1.	3.3	
Center-East	Center	77.8	18.4	2.4	
Center-East	Italy	37.	21.3	2.7	
Center	France	28.	4.3	1.4	
Center	Italy	20.2	9.1	3.5	
Netherlands	Belgium	53.	10.7	0.5	
Netherlands	Center	80.	11.7	0.6	
Netherlands	UK	15.3	7.	1.	
Poland	Center	31.4	24.4	3.2	
UK	Belgium	25.5	7.5	1.5	
Out of Regional Scope					
Algeria	Italy	25.4	25.4	6.2	Cont.Eur
France	SpainPort	1.1	1.1	3.2	Cont.Eur
Iraq	TurkeyE	0.	0.	1.7	Iraq, Turkey
Libya	Italy	9.	9.	4.7	Cont.Eur

[a] The unit cost is given for flows up to 75% of the capacity. For the remaining 25% of capacity the numbers are increased by 20%.

A.1.4 LNG

In the model the LNG gas is considered as nonstrategic since a single LNG exporter's market share in the Eurasian gas trade is small relative to the market power of the suppliers of the pipeline gas. Incorporation of the global LNG market into a cooperative game would be challenging. Since the LNG gas is a common source and globally open to all players, actions of players outside of the considered coalition have to be taken into account. They will form alternative coalitions which may tap the LNG market and change the availability of the LNG supplies. Since the focus of the paper is on pipeline gas, the LNG market is not modeled explicitly.

The LNG regasification plants, also called terminals, are represented as LNG links. They are considered as instruments, but it is assumed that they are connected to areas outside of the regional scope. Therefore, the LNG capacities in 2009 are limited to flows in the respective year, and then, they are extended by the forecasted capacity investments between 2009 and 2015. Data for LNG capacities in 2009 and 2015 are collected from IEA (2011a), GIE (2010) and GIE (2011). LNG capacities of China are taken from Higashi (2009). Imports through the LNG terminals in 2009 are compiled from IEA (2010b) and IEA (2011a). Comparing the Tables 13.5 and 13.6 in IEA (2009), it is assumed that the total cost (sum of production and transportation costs) of gas which is imported through the LNG terminals is $2c^P$. Similar to the production and transportation costs, total cost of LNG is assumed to be piecewise linear : $T_{ij}(q) = 2c^P(\min[q, 0.75 * k_{ij}] + 1.2\max[q - 0.75 * k_{ij}, 0])$. Figures for the LNG links are presented in Table A.4.

Table A.4: Pipeline Network: LNG regasification plants

Links from	Links to	Capacity [bcm/a]	Flow [bcm/a]	Cost[a] $c_p + \Delta_i$ [mn €/bcm]	needed for access
BalkanLNG	Balkan	2.8	0.8	$2c_p$	Balkan
BelgiumLNG	Belgium	6.	3.	$2c_p$	Cont.Eur
FranceLNG	France	23.1	10.1	$2c_p$	Cont.Eur
CenterLNG	CenterS	0.	0.	$2c_p$	Cont.Eur
ItalyLNG	Italy	6.7	2.9	$2c_p$	Cont.Eur
NetherlandsLNG	Netherlands	16.	0.	$2c_p$	Cont.Eur
PolandLNG	Poland	5.	0.	$2c_p$	Cont.Eur
TurkeyLNG	Turkey	6.1	6.1	$2c_p$	Turkey
UKLNG	UK	10.1	10.1	$2c_p$	UK
ChinaLNG	China	39.4	7.6	$2c_p$	China

[a] The global parameter c_p is set equal to 20. The unit cost is given for flows up to 75% of the capacity. For the remaining 25% of capacity the numbers are increased by 20%.

A.1.5 New Projects

Several public sources are consulted for information about the pipeline projects. Cost estimates of the project consortia are supplemented by own estimates if figures are unavailable, outdated or subject to review. A rather high discount rate of 15% is used to translate capital expenditures into annualized capacity cost. This rate is a common hurdle rate in the gas industry and reflects the real option nature of the investment and depreciation. Table A.5 summarizes the information presented in Section 2.

Table A.5: Pipeline Network: New Pipelines

Links		Capacity[a] old + new	Flow	Operation Cost: c_{ij}^T	Capacity Cost[b]		required for for access
from	to	[bcm/a]	[bcm/a]	[mn €/bcm]	[bn €]	[bn €/a]	
Turkmenistan-China							
Turkmenistan	UzbekistanTC	0 + 30	–	1.1	1.7	0.3	Turkmenistan ,Uzbekistan
UzbekistanTC	KazakhstanE	0 + 30	–	1.6	2.6	0.4	Kazakhstan ,Uzbekistan
KazakhstanE	China	0 + 30	–	17.4	4.7	0.7	Kazakhstan ,China
Trans Anatolian (TANAP)							
Azerbaijan	TurkeyE	7 + 16	4.5	2.4	2.4	0.4	Azerbaijan ,Turkey
TurkeyE	Turkey	20 + 16	11.8	2.4	2.4	0.4	Turkey
Trans Adriatic (TAP)							
Balkan	Turkey[c]	16.3 + 10	8.9	1.8	1.	0.2	Turkey
Balkan	Italy	0 + 10	–	3.9	2.3	0.3	Cont.Eur.[d] ,Azerbaijan
Nabucco-West							
Balkan	Turkey[d]	16.3 + 10	8.9	1.8	1.	0.2	Turkey
Center-EastNab	BalkanNab[e]	0 + 10	–	3.3	4.	0.6	Cont.Eur. ,Azerbaijan
Trans Caspian (via the Caspian Sea)							
Turkmenistan	Azerbaijan	0 + 20	–	0.9	3.5	0.5	Azerbaijan ,Turkmenistan
TTP (via Iran)							
Turkmenistan	Iran	20 + 15	5.8	2.3	6.4	1.	Turkmenistan ,Iran
Iran	TurkeyE	13.7 + 15	7.2	1.2	3.4	0.5	Iran ,Turkey
South Stream (via Russia)							
RussiaS	Balkan	0 + 63	–	5.6	10.	1.5	Russia
Center-EastSS	BalkanSS[f]	0 + 30	–	3.3	5.5	0.8	Russia

[a] Existing capacity as compiled from ENTSOG (2010) and public sources + planned capacity

[b] Capacity expenditure (left column) is converted to annualized capacity-cost (right column) using a discount rate of 15%.

[c]Currently gas flows from Balkan to Turkey. The projects plan to revert the flow.

[d]To reduce the number of players, Continental Europe (Cont.Eur.) stands for all European players except UK and Balkan.

[e]Currently gas flows from Center-East to Balkan through the link {Center-East, Balkan} as presented in Table A.3. The projects plan to revert the flow.

B Tables

Table B.1: Southern Corridor: Impact on Bargaining Power [bn €/a]

	Bench-mark[a]	Impact of pipelines (difference to column 1) TCP +TANAP	TCP +TANAP +NabW[b]	TCP +TANAP +TAP[c]
Azerbaijan	1.1	1.1	1.	1.2
Kazakhstan	0.6	0.	0.	0.
Turkmenistan	0.7	0.5	0.5	0.5
Uzbekistan	0.5	0.	0.	0.
Balkan	1.3	0.1	0.2	0.1
Cont.Eur.	32.2	0.2	0.1	0.3
UK	12.6	0.	0.1	0.1
Turkey	14.3	1.1	1.5	1.2
Russia	30.7	−1.9	−1.8	−1.8
Ukraine	15.3	−0.3	−0.8	−0.5
Belarus	10.8	0.	0.	0.
Iran	1.9	−0.3	−0.4	−0.3
Norway	19.8	−0.3	−0.3	−0.6
China	0.5	0.	0.	0.
project cost[d]	–	1.2	1.8	1.7

[a] The Turkmenistan-China pipeline is in operation and serves Central Asian gas to Chinese markets.

[b] Half of Nabucco-West's capacity is exempt from the EU's third party access regulation. Only half of the pipeline's capacity is open to the third party access. Other half of the capacity is reserved for the coalitions containing Azerbaijan and Continental Europe.

[c] TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[d] Investment cost annualized with an interest of 15%.

Table B.2: Can South Stream prevent investment in the Southern Corridor? [bn €/a]

	Impact of pipelines					
	w/o South Stream			w/ South Stream		
Players	Bench-mark[a]	TCP+TANAP +NabW[b]	TCP+TANAP +TAP[c]	Bench-mark[a]	TCP+TANAP +NabW	TCP+TANAP +TAP
Azerbaijan	1.1	1.	1.2	0.9	0.9	1.1
Kazakhstan	0.6	0.	0.	0.6	0.	0.
Turkmenistan	0.7	0.5	0.5	0.7	0.5	0.5
Uzbekistan	0.5	0.	0.	0.5	0.	0.
Balkan	1.3	0.2	0.1	1.7	0.1	0.
Cont.Eur.	32.2	0.1	0.3	33.4	0.3	0.3
UK	12.6	0.1	0.1	12.9	0.1	0.1
Turkey	14.3	1.5	1.2	14.6	1.3	1.
Russia	30.7	−1.8	−1.8	32.6	−2.1	−2.
Ukraine	15.3	−0.8	−0.5	13.3	−0.4	−0.1
Belarus	10.8	0.	0.	10.4	0.	0.
Iran	1.9	−0.4	−0.3	1.6	−0.3	−0.2
Norway	19.8	−0.3	−0.6	18.6	−0.3	−0.5
China	0.5	0.	0.	0.5	0.	0.
project cost[d]	–	1.8	1.7	–	1.8	1.7

[a]The Turkmenistan-China pipeline is in operation and serves Central Asian gas to Chinese markets.

[b]Half of Nabucco-West's capacity is exempt from the EU's third party access regulation. Only half of the pipeline's capacity is open to the third party access. Other half of the capacity is reserved for the coalitions containing Azerbaijan and Continental Europe.

[c]TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[d]Investment cost annualized with an interest of 15%.

C Robustness: Investment Options

Table C.1: The Central Asian countries' pipeline options: Impact on the bargaining power [bn €/a]

		Impact of pipelines (difference to column 1)			
		to the East	to the West		
			Southern Corridor[a]		via Russia
Players	Bench-mark[b]	Turkm. -China	via Caspian +TCP	via Iran +TTP	South Stream
Azerbaijan	1.7	0.	0.2	0.1	0.
Kazakhstan	0.3	0.2	0.	0.	0.
Turkmenistan	2.	0.2	0.1	0.1	0.
Uzbekistan	0.3	0.2	0.	0.	0.
Balkan	1.7	0.	0.	0.	0.
Cont.Eur.	34.7	0.	0.1	0.1	0.3
UK	13.5	0.	0.	0.	0.1
Turkey	17.9	0.	0.2	0.3	0.
Russia	27.1	0.1	−0.4	−0.5	0.4
Ukraine	12.7	0.	−0.1	−0.1	−0.5
Belarus	10.4	0.	0.	0.	−0.1
Iran	1.9	0.	0.	0.2	0.
Norway	16.8	0.	−0.1	−0.1	−0.2
China	0.2	0.2	0.	0.	0.
project cost[c]		1.4	1.7	2.7	2.3

[a]The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b]The Turkmenistan-China pipeline is not in operation yet. China is not connected to the Eurasian gas trade via pipelines.

[c]Investment cost annualized with an interest of 15%.

Table C.2: The Central Asian countries' westbound pipeline options: Impact on the players' bargaining power [bn €/a]

		Impact of pipelines (difference to column 1)					
					to the West		
		Southern Corridor			Southern Corridor[a]		via Russia
	Bench-mark[b]	TANAP	TANAP +NabW[c]	TANAP +TAP[d]	via Caspian +TCP	via Iran +TTP	South Stream
Azerbaijan	1.7	0.1	0.1	0.1	0.2	0.1	0.
Kazakhstan	0.5	0.	0.	0.	0.	0.	0.
Turkmenistan	2.2	0.	0.1	0.1	0.1	0.1	0.
Uzbekistan	0.5	0.	0.	0.	0.	0.	0.
Balkan	1.7	0.	0.	0.	0.	0.	0.
Cont.Eur.	34.7	0.	0.1	0.1	0.1	0.1	0.3
UK	13.5	0.	0.	0.	0.	0.	0.1
Turkey	17.9	0.1	0.2	0.2	0.2	0.3	0.
Russia	27.2	–0.2	–0.3	–0.3	–0.4	–0.5	0.4
Ukraine	12.7	–0.1	–0.2	–0.1	–0.1	–0.1	–0.5
Belarus	10.4	0.	0.	0.	0.	0.	–0.1
Iran	1.9	0.	0.	0.	0.	0.2	0.
Norway	16.8	0.	–0.1	–0.1	–0.1	–0.1	–0.2
China	0.4	0.	0.	0.	0.	0.	0.
project cost[e]	–	0.7	1.5	1.2	1.7	2.7	2.3

[a] The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b] The Turkmenistan-China pipeline is in operation and serves Central Asian gas to Chinese markets.

[c] Half of Nabucco-West's capacity is exempt from the EU's third party access regulation. Only half of the pipeline's capacity is open to the third party access. Other half of the capacity is reserved for the coalitions containing Azerbaijan and Continental Europe.

[d] TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[e] Investment cost annualized with an interest of 15%.

D Robustness: Demand of China

Table D.1: The Central Asian countries' pipeline options: Impact on the bargaining power [bn €/a]

Players	Bench-mark[b]	Impact of pipelines (difference to column 1): to the East: Turkm.-China	to the West: Southern Corridor[a]: via Caspian +TCP	to the West: Southern Corridor[a]: via Iran +TTP	to the West: via Russia: South Stream
Azerbaijan	1.1	0.	1.2	0.5	−0.2
Kazakhstan	0.1	1.9	0.	0.	0.
Turkmenistan	0.2	1.9	0.5	0.3	0.
Uzbekistan	0.	1.9	0.	0.	0.
Balkan	1.3	0.	0.1	0.1	0.3
Cont.Eur.	32.2	0.	0.3	0.3	1.3
UK	12.6	0.	0.1	0.1	0.3
Turkey	14.3	0.	1.2	1.5	0.3
Russia	30.7	0.	−1.8	−2.1	1.9
Ukraine	15.3	0.	−0.5	−0.5	−2.
Belarus	10.8	0.	0.	0.	−0.4
Iran	1.9	0.	−0.3	0.6	−0.3
Norway	19.8	0.	−0.6	−0.7	−1.3
China	0.	1.9	0.	0.	0.
project cost[c]		1.4	1.7	2.7	2.3

[a]The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b]The Turkmenistan-China pipeline is not in operation yet. China is not connected to the Eurasian gas trade via pipelines.

[c]Investment cost annualized with an interest of 15%.

Table D.2: The Central Asian countries' westbound pipeline options: Impact on the players' bargaining power [bn €/a]

		Impact of pipelines (difference to column 1)					
					to the West		
		Southern Corridor			Southern Corridor[a]		via Russia
	Bench-mark[b]	TANAP	TANAP +NabW[c]	TANAP +TAP[d]	via Caspian +TCP	via Iran +TTP	South Stream
Azerbaijan	1.1	0.6	0.5	0.7	1.2	0.5	−0.2
Kazakhstan	2.	0.	0.	0.	0.	0.	0.
Turkmenistan	2.2	0.	0.	0.	0.5	0.3	0.
Uzbekistan	2.	0.	0.	0.	0.	0.	0.
Balkan	1.3	0.1	0.2	0.	0.1	0.1	0.3
Cont.Eur.	32.1	0.	0.	0.2	0.3	0.3	1.3
UK	12.6	0.	0.	0.	0.1	0.1	0.3
Turkey	14.3	0.6	1.1	0.7	1.2	1.5	0.3
Russia	30.7	−0.6	−0.6	−0.6	−1.8	−2.1	1.9
Ukraine	15.3	−0.3	−0.9	−0.5	−0.5	−0.5	−2.
Belarus	10.8	0.	0.	−0.1	0.	0.	−0.4
Iran	1.9	−0.2	−0.3	−0.2	−0.3	0.6	−0.3
Norway	19.8	−0.2	−0.1	−0.3	−0.5	−0.6	−1.2
China	1.9	0.	0.	0.	0.	0.	0.
project cost[e]	–	0.7	1.5	1.2	1.7	2.7	2.3

[a] The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b] The Turkmenistan-China pipeline is in operation and serves Central Asian gas to Chinese markets.

[c] Half of Nabucco-West's capacity is exempt from the EU's third party access regulation. Only half of the pipeline's capacity is open to the third party access. Other half of the capacity is reserved for the coalitions containing Azerbaijan and Continental Europe.

[d] TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[e] Investment cost annualized with an interest of 15%.

E Robustness: Demand Intercept

E.1 Demand Intercept: 1500 mn €/bcm

Table E.1: The Central Asian countries' pipeline options: Impact on the bargaining power [%]

		Impact of pipelines *(difference to column 1)*			
		to the East	to the West		
			Southern Corridor[a]		via Russia
Players	Bench-mark[b]	Turkm. -China	via Caspian +TCP	via Iran +TTP	South Stream
Azerbaijan	0.8	0.	0.9	0.3	−0.1
Kazakhstan	0.1	0.3	0.	0.	0.
Turkmenistan	0.2	0.3	0.3	0.2	0.
Uzbekistan	0.	0.3	0.	0.	0.
Balkan	1.	0.	0.	0.1	0.2
Cont.Eur.	22.9	−0.3	0.2	0.2	0.9
UK	9.	−0.1	0.1	0.1	0.2
Turkey	10.2	−0.1	0.8	1.1	0.2
Russia	21.9	−0.3	−1.3	−1.5	1.4
Ukraine	10.9	−0.1	−0.3	−0.3	−1.4
Belarus	7.7	−0.1	0.	0.	−0.3
Iran	1.3	0.	−0.2	0.4	−0.2
Norway	14.1	−0.2	−0.4	−0.5	−0.9
China	0.	0.3	0.	0.	0.

[a]The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b]The Turkmenistan-China pipeline is not in operation yet. China is not connected to the Eurasian gas trade via pipelines.

Table E.2: The Central Asian countries' westbound pipeline options: Impact on the players' bargaining power [%]

		Impact of pipelines (difference to column 1)					
					to the West		
		Southern Corridor			Southern Corridor[a]		via Russia
	Bench-mark[b]	TANAP	TANAP +NabW[c]	TANAP +TAP[d]	via Caspian +TCP	via Iran +TTP	South Stream
Azerbaijan	0.8	0.4	0.4	0.5	0.9	0.3	−0.1
Kazakhstan	0.4	0.	0.	0.	0.	0.	0.
Turkmenistan	0.5	0.	0.	0.	0.3	0.2	0.
Uzbekistan	0.3	0.	0.	0.	0.	0.	0.
Balkan	0.9	0.	0.2	0.	0.	0.1	0.2
Cont.Eur.	22.6	0.	0.	0.1	0.2	0.2	0.9
UK	8.8	0.	0.	0.	0.1	0.1	0.2
Turkey	10.1	0.4	0.7	0.5	0.8	1.1	0.2
Russia	21.6	−0.4	−0.4	−0.4	−1.3	−1.5	1.4
Ukraine	10.8	−0.2	−0.6	−0.3	−0.3	−0.3	−1.4
Belarus	7.6	0.	0.	0.	0.	0.	−0.3
Iran	1.3	−0.1	−0.2	−0.2	−0.2	0.4	−0.2
Norway	13.9	−0.1	−0.1	−0.2	−0.4	−0.5	−0.9
China	0.3	0.	0.	0.	0.	0.	0.

[a] The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b] The Turkmenistan-China pipeline is in operation and serves Central Asian gas to Chinese markets.

[c] Half of Nabucco-West's capacity is exempt from the EU's third party access regulation. Only half of the pipeline's capacity is open to the third party access. Other half of the capacity is reserved for the coalitions containing Azerbaijan and Continental Europe.

[d] TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

E.2 Demand Intercept: 500 mn €/bcm

Table E.3: The Central Asian countries' pipeline options: Impact on the bargaining power [bn €/a]

Players	Bench-mark[b]	Impact of pipelines (difference to column 1): to the East – Turkm.-China	to the West – Southern Corridor[a] – via Caspian +TCP	to the West – Southern Corridor[a] – via Iran +TTP	to the West – via Russia – South Stream
Azerbaijan	0.4	0.	0.4	0.2	−0.1
Kazakhstan	0.1	0.1	0.	0.	0.
Turkmenistan	0.1	0.1	0.2	0.1	0.
Uzbekistan	0.	0.1	0.	0.	0.
Balkan	0.5	0.	0.	0.	0.1
Cent.Eur.	11.1	0.	0.1	0.1	0.4
UK	4.4	0.	0.	0.	0.1
Turkey	4.9	0.	0.4	0.5	0.1
Russia	10.7	0.	−0.6	−0.7	0.7
Ukraine	5.3	0.	−0.2	−0.2	−0.7
Belarus	3.7	0.	0.	0.	−0.1
Iran	0.7	0.	−0.1	0.2	−0.1
Norway	7.6	0.	−0.2	−0.2	−0.4
China	0.	0.1	0.	0.	0.
project cost[c]		1.4	1.7	2.7	2.3

[a] The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b] The Turkmenistan-China pipeline is not in operation yet. China is not connected to the Eurasian gas trade via pipelines.

[c] Investment cost annualized with an interest of 15%.

Table E.4: The Central Asian countries' westbound pipeline options: Impact on the players' bargaining power [bn €/a]

		Impact of pipelines (difference to column 1)						
					to the West			
		Southern Corridor			Southern Corridor[a]		via Russia
	Bench-mark[b]	TANAP	TANAP +NabW[c]	TANAP +TAP[d]	via Caspian +TCP	via Iran +TTP	South Stream
Azerbaijan	0.4	0.2	0.2	0.2	0.4	0.2	–0.1
Kazakhstan	0.2	0.	0.	0.	0.	0.	0.
Turkmenistan	0.3	0.	0.	0.	0.2	0.1	0.
Uzbekistan	0.2	0.	0.	0.	0.	0.	0.
Balkan	0.5	0.	0.1	0.	0.	0.	0.1
Cent.Eur.	11.1	0.	0.	0.	0.1	0.1	0.4
UK	4.3	0.	0.	0.	0.	0.	0.1
Turkey	4.9	0.2	0.4	0.2	0.4	0.5	0.1
Russia	10.7	–0.2	–0.2	–0.2	–0.6	–0.7	0.7
Ukraine	5.3	–0.1	–0.3	–0.2	–0.2	–0.2	–0.7
Belarus	3.7	0.	0.	0.	0.	0.	–0.1
Iran	0.7	–0.1	–0.1	–0.1	–0.1	0.2	–0.1
Norway	7.7	0.	0.	–0.1	–0.2	–0.2	–0.4
China	0.1	0.	0.	0.	0.	0.	0.
project cost[e]	–	0.7	1.5	1.2	1.7	2.7	2.3

[a]The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b]The Turkmenistan-China pipeline is in operation and serves Central Asian gas to Chinese markets.

[c]Half of Nabucco-West's capacity is exempt from the EU's third party access regulation. Only half of the pipeline's capacity is open to the third party access. Other half of the capacity is reserved for the coalitions containing Azerbaijan and Continental Europe.

[d]TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[e]Investment cost annualized with an interest of 15%.

Table E.5: The Central Asian countries' pipeline options: Impact on the bargaining power [%]

Players	Bench-mark[b]	Impact of pipelines (difference to column 1) to the East: Turkm. -China	to the West: Southern Corridor[a] via Caspian +TCP	to the West: Southern Corridor[a] via Iran +TTP	to the West: via Russia South Stream
Azerbaijan	0.8	0.	0.9	0.3	−0.1
Kazakhstan	0.1	0.3	0.	0.	0.
Turkmenistan	0.3	0.3	0.4	0.3	0.
Uzbekistan	0.	0.3	0.	0.	0.
Balkan	0.9	0.	0.	0.1	0.2
Cent.Eur.	22.5	−0.2	0.1	0.2	0.8
UK	8.8	−0.1	0.	0.	0.2
Turkey	9.8	−0.1	0.8	1.1	0.2
Russia	21.6	−0.2	−1.3	−1.5	1.4
Ukraine	10.8	−0.1	−0.3	−0.4	−1.5
Belarus	7.5	−0.1	0.	0.	−0.3
Iran	1.4	0.	−0.2	0.4	−0.2
Norway	15.5	−0.1	−0.4	−0.5	−0.8
China	0.	0.3	0.	0.	0.

[a]The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b]The Turkmenistan-China pipeline is not in operation yet. China is not connected to the Eurasian gas trade via pipelines.

Table E.6: The Central Asian countries' westbound pipeline options: Impact on the players' bargaining power [%]

		Impact of pipelines (difference to column 1)					
					to the West		
		Southern Corridor			Southern Corridor[a]		via Russia
	Bench-mark[b]	TANAP	TANAP +NabW[c]	TANAP +TAP[d]	via Caspian +TCP	via Iran +TTP	South Stream
Azerbaijan	0.8	0.4	0.4	0.5	0.9	0.3	–0.1
Kazakhstan	0.4	0.	0.	0.	0.	0.	0.
Turkmenistan	0.5	0.	0.	0.	0.4	0.2	0.
Uzbekistan	0.3	0.	0.	0.	0.	0.	0.
Balkan	0.9	0.	0.2	0.	0.	0.1	0.2
Cent.Eur.	22.2	0.	0.	0.1	0.2	0.2	0.8
UK	8.7	0.	0.	0.	0.	0.	0.2
Turkey	9.7	0.4	0.7	0.5	0.8	1.1	0.2
Russia	21.4	–0.4	–0.4	–0.4	–1.3	–1.4	1.3
Ukraine	10.7	–0.2	–0.6	–0.3	–0.3	–0.3	–1.4
Belarus	7.4	0.	0.	–0.1	0.	0.	–0.3
Iran	1.3	–0.1	–0.2	–0.1	–0.2	0.4	–0.2
Norway	15.3	–0.1	0.	–0.2	–0.4	–0.4	–0.8
China	0.3	0.	0.	0.	0.	0.	0.

[a] The Southern Corridor is composed of TANAP and TAP. TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.

[b] The Turkmenistan-China pipeline is in operation and serves Central Asian gas to Chinese markets.

[c] Half of Nabucco-West's capacity is exempt from the EU's third party access regulation. Only half of the pipeline's capacity is open to the third party access. Other half of the capacity is reserved for the coalitions containing Azerbaijan and Continental Europe.

[d] TAP is exempt from the EU's third party access regulation. Only coalitions containing Azerbaijan and Continental Europe can ship gas through the pipeline.